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CITY COUNTY STATE

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Vol. 58 November, 1927 No. 11

Temperatures in Denver Reservoirs

Measurements at different depths. Comparisons with air temperatures. Stagnation and circulation periods. Dissolved oxygen content.

By Ivan E. Houk

Many measurements of water temperature in Denver's water supply reservoirs have been made by engineers of the Denver Board of Water Commissioners under the direction of chief engineer D. D. Gross. For some time periodic measurements of water temperature have been made at different depths in Marston Lake, one of the impounding reservoirs near Denver, in connection with the necessary sanitary analyses of the water. Miscellaneous temperature measurements have also been made at different depths in Lake Cheesman, the twenty-six billion gallon storage reservoir which constitutes the principal storage unit of the system. Lake Cheesman is located in the mountains southwest of Denver, approximately fifty miles distant by air line and sixty miles by road. Periodic analyses of the water at Lake Cheesman are not necessary since all water released for municipal water supply is restored in impounding or distributing reservoirs near the city, where it is filtered and analysed before entering the city mains.

Figure 2 shows some water temperatures at different depths in Lake Cheesman, observed by superintendent R. F. Gray, October 1, 1926. The measurements were made in the galleries within and beneath the dam, by holding an ordinary bulb thermometer in the discharge or leakage of the valves at the different levels, or by placing it in the drainage at accessible rock seams where the temperature of the water could not differ materially from that of the reservoir at the corresponding elevations. The diagram indicates that the heating of the reservoir

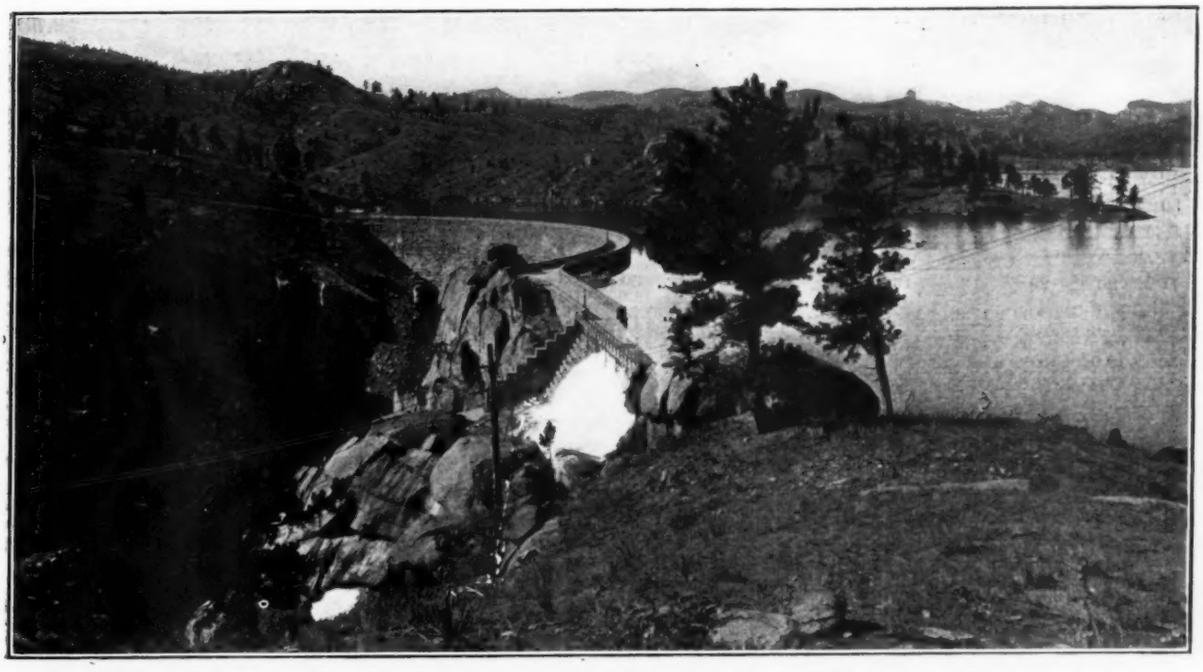


FIG. 1—CHEESMAN DAM AND THE EASTERN PART OF LAKE CHEESMAN, LOOKING SOUTHWEST, SHOWING A SMALL QUANTITY OF WATER FLOWING OVER THE SPILLWAY

water in the summer of 1926 had been appreciable at depths of sixty feet or less, that it had not been appreciable at depths of a hundred feet or more, and that the temperature of the water in the bottom of the reservoir, approximately a hundred and ninety feet below the surface, was only slightly higher than the temperature of maximum density. The vertical part of the curve near the surface of the reservoir probably means that the surface water had been warmer earlier in the fall, and that it was then cooling as a result of the lowering air temperatures. The mean air temperature on October 1 was only 53 degrees Fahrenheit, considerably lower than it had been during July, August, and the early part of September. The observations of water temperature show a decrease of five degrees between depths of fifty and fifty-seven feet. While measurements at intermediate depths might have shown the greater part of this decrease to have occurred suddenly, it is evident that there was no definite thermocline present, such as was observed at the Kensico Reservoir in the summer of 1916, described by F. E. Hale and J. E. Dowd in the *Journal of Industrial and Engineering Chemistry* for April 1917.

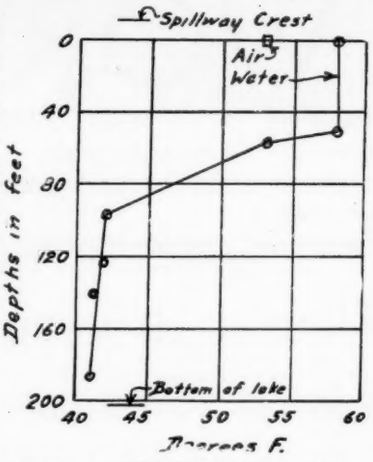


FIG. 2—TEMPERATURE OF WATER IN LAKE CHEESMAN, OCT. 1, 1926

Observations made at the upper end of Lake Cheesman during the summer months, when the inflowing river water was several degrees colder than the water at the surface of the lake, show that the inflow dips down to the level of its temperature immediately on entering the reservoir. In fact, one instance was observed where cold, turbid, river water entered the reservoir at the upper end, dipped down to the level of its temperature, flowed through the reservoir at that level, and came out of the discharge valves at the dam in practically the same condition it was in when it reached the reservoir. Incidentally it might be mentioned that Lake Cheesman has an average depth of approximately ninety feet, when full; that it seldom freezes to depths greater than a foot although located in the mountains at an elevation of about 6,900 feet above mean sea level; and that the temperature of the water near the bottom of the dam never varies mre than one degree, either way, from a mean value of 40 degrees Fahrenheit.

Table 1 gives the results of temperature measurements at different depths in Marston Lake, made by chemist George J. Turre during the period from April 1, 1924, to March 31, 1925. Temperatures of the water are given in degrees Centigrade for depths of 0, 5, 10, 15, 30, and 45 feet below the surface. Measurements were made by lowering an empty 32-ounce bottle to the desired depth, removing the cork by means of a string suitably attached,

Table 1—Temperature of Water at Different Depths in Marston Lake, near Denver, in Degrees Centrigrade.

	Days of Month, April, 1924						May, 1924							June, 1924				
D*	1	4	15	18	25	29	2	7	9	13	16	20	23	3	6	10	13	17
0	3.8	4.1	7.9	7.9	8.5	10.5	11.0	13.0	11.0	13.0	14.0	13.8	13.8	17.9	15.8	16.5	20.0	23.3
5	3.8	4.1	..	..	8.5	8.9	10.0	12.0	10.0	11.9	13.9	13.2'	13.7	15.0	14.3	15.7	19.1	20.4
10	3.8	4.1	..	..	8.5	8.9	9.8	11.0	10.0	11.8	13.3	13.2	13.6	13.9	13.5	15.5	18.9	19.5
15	3.8	4.1	..	..	8.5	8.9	9.5	10.7	10.0	11.0	12.5	13.0	13.5	12.8	13.0	15.1	17.7	17.9
30	3.8	4.1	7.8	7.0	8.5	8.7	9.0	10.0	9.7	10.5	10.8	12.2	12.4	12.5	12.7	13.5	14.5	15.1
45	3.8	4.1	7.7	6.9	8.5	8.7	9.0	9.7	9.0	10.0	10.1	10.8	11.8	12.5	12.5	13.2	14.0	15.0

	June, 1924						July, 1924							August, 1924				
D	20	24	27	30	3	8	11	15	18	22	25	28	31	5	8	11	19	22
0	18.1	21.0	23.7	22.5	21.5	22.6	21.6	24.5	21.5	22.5	23.2	22.5	21.6	23.2	21.8	22.0	21.5	21.5
5	18.0	20.5	22.5	20.7	21.0	21.6	21.5	22.0	21.0	22.0	21.5	22.5	21.5	22.1	22.5	20.9	21.0	20.6
10	17.8	19.6	21.0	20.0	20.5	21.5	21.4	21.4	21.0	22.0	21.2	21.8	21.2	21.8	21.2	20.8	20.6	20.2
15	17.5	18.8	19.0	19.0	20.8	20.8	20.5	21.0	21.0	22.0	21.0	21.0	20.8	21.2	21.0	20.0	20.2	21.0
30	15.4	17.1	17.0	17.5	17.5	18.0	17.2	19.0	19.5	19.5	19.5	20.5	19.4	20.0	20.0	...	19.5	19.2
45	15.0	16.0	15.7	16.5	17.0	16.2	16.5	17.6	17.0	17.5	17.5	18.0	17.2	18.2	18.0	...	18.3	17.9

	August		September, 1924						October, 1924								November	
D	26	29	12	16	19	23	26	30	3	7	10	14	21	24	28	30	4	7
0	21.4	20.0	18.1	18.0	16.0	16.9	15.1	14.6	13.2	12.9	12.2	12.9	12.9	12.0	12.9	11.1	10.7	9.5
5	20.9	20.6	17.8	17.6	16.0	16.7	15.1	14.6	13.2	12.9	12.2	12.8	12.8	12.0	12.8	11.1	10.5	9.5
10	20.6	20.3	17.6	17.2	16.0	16.0	15.1	14.6	13.0	12.9	12.2	11.8	12.8	12.0	12.5	11.1	10.5	9.3
15	20.5	20.0	17.6	17.0	16.0	16.0	15.1	14.5	12.8	12.8	12.2	11.8	12.5	12.0	12.3	11.1	10.5	9.2
30	19.0	19.5	17.5	16.9	16.0	15.8	15.1	14.4	12.8	12.8	12.2	11.8	12.2	12.0	12.2	11.1	10.5	9.0
45	18.1	18.5	17.0	16.5	16.0	15.8	15.1	14.4	12.8	12.8	12.2	11.6	12.2	11.9	12.2	11.1	10.5	9.0

	November, 1924				December, 1924								January, 1925					
D	10	14	18	21	2	5	9	12	16	23	26	30	3	6	9	13	16	23
0	8.3	6.7	6.5	6.2	3.3	3.0	0.0	2.8	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	8.4	6.7	6.5	6.2	3.5	3.1	..	..	2.8	..	2.3	1.0	2.2	2.5	2.7	2.7	2.8	2.9
10	8.5	6.5	6.5	6.2	3.7	3.1	..	..	2.8	..	2.4	1.8	2.3	2.7	2.8	2.8	2.8	3.2
15	8.5	6.5	6.5	6.2	3.7	3.1	..	..	2.8	..	2.4	2.3	2.3	2.7	2.8	2.8	2.8	3.2
30	8.5	6.5	6.5	6.2	3.7	3.1	3.8	3.1	2.8	2.2	2.7	2.5	2.8	3.0	2.8	2.8	2.8	3.3
45	8.5	6.5	6.5	6.2	3.7	3.1	3.4	3.1	2.8	2.2	2.8	2.5	2.8	3.0	3.0	3.0	3.0	3.5

	January		February, 1925						March, 1925									
D	27	30	3	6	10	13	18	20	24	27	3	6	10	13	20	24	27	31
0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8	0.8	4.0	5.5	4.8	4.0	4.8	5.7	7.4	9.8
5	3.0	3.3	3.8	3.9	3.9	3.9	5.0	4.2	..	..	..	..	4.8	..	4.9	5.7	7.0	10.1
10	3.0	3.4	3.8	3.9	3.9	3.9	4.8	4.2	..	..	..	..	4.8	..	4.7	5.7	6.8	9.8
15	3.0	3.4	3.8	3.9	3.9	3.9	4.5	4.2	..	..	..	..	4.8	..	5.0	5.6	6.8	9.5
30	3.2	3.4	3.8	3.9	3.9	3.9	4.3	4.2	4.5	4.3	4.5	5.0	4.8	4.4	4.8	5.6	6.8	9.2
45	3.5	3.5	3.8	3.9	3.9	3.9	4.2	4.2	4.2	4.3	4.2	4.8	4.8	4.2	4.8	5.6	6.7	9.0

*D = Depth below surface in feet.

allowing the bottle to fill, then drawing it rapidly to the surface and observing the temperature. The samples were then preserved for microscopic analyses and determinations of dissolved oxygen content.

Marston Lake has an area of 652 acres, when full, an average depth of 30 feet, a maximum depth of 65 feet, and a total capacity of 19,793 acre feet, or approximately 6,400,000,000 gallons. This quantity is sufficient to supply the 315,000 inhabitants of Denver for a period of about 16 weeks, assuming a mean daily consumption of 178 gallons per capita, which was the mean rate for the year 1926. Although the water surface is drawn down about fifteen feet in the fall of the year to permit cleaning of the shore line, the reservoir is kept full the greater part of the time. Water diverted from the South Platte river near the mouth of the canyon, about ten miles south of Marston Lake, is brought northward through two wood stave pipe lines and discharged into the south side of the lake at about the same rate that water is taken out through the new filtration plant at the norh side. A small quantity of water, diverted from Bear creek, near Morrison, is discharged into the reservoir at the west side; and a small flow is withdrawn from the reservoir through the filtration plant at the southeast corner of the lake. Consequently considerable circulation is taking place throughout the reservoir at all times.

In Figure 3 a few of the series of temperature observations from Table 1 are platted as abscissas against depths below the surface as ordinates, temperatures being shown on the Fahrenheit scale. Thus the curves illustrate the changes in temperature which occur at different depths in the lake during different seasons of the year. Since the density of the water varies with the temperature, the curves also indicate the existence or non-existence of vertical currents; that is, the occurrence of periods of circulation or stagnation. On April 1 the vertical column had a uniform temperature of 39.2 degrees, thus indicating that the reservoir had been experiencing its spring period of circulation. The summer period of stagnation began sometime in April and continued until sometime in September. During this period the water temperatures reached values as high as 75 degrees at the surface and as high as 65 degrees at the 45-foot depth, the heating at the lower depths being caused by direct penetration of light rays and by circulation resulting from wind

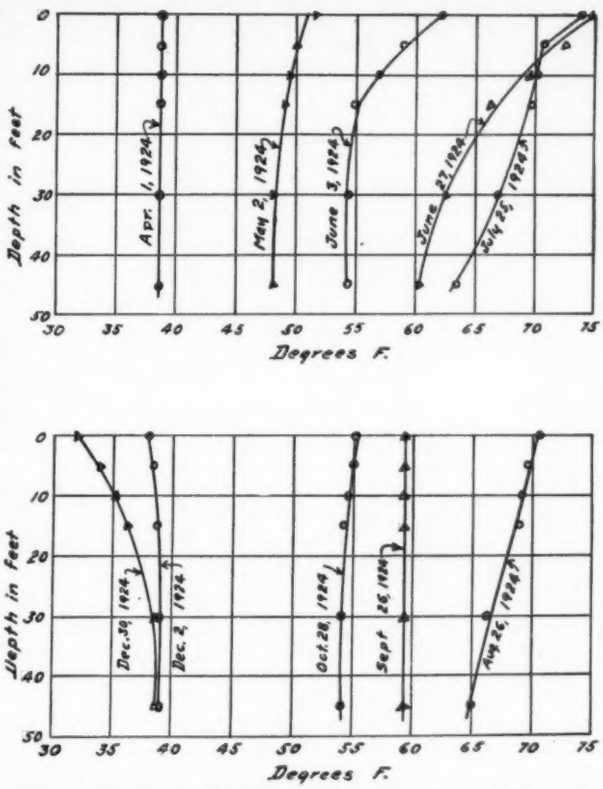


FIG. 3—TEMPERATURES OF WATER IN MARSTON LAKE, NEAR DENVER, DURING THE YEAR 1924

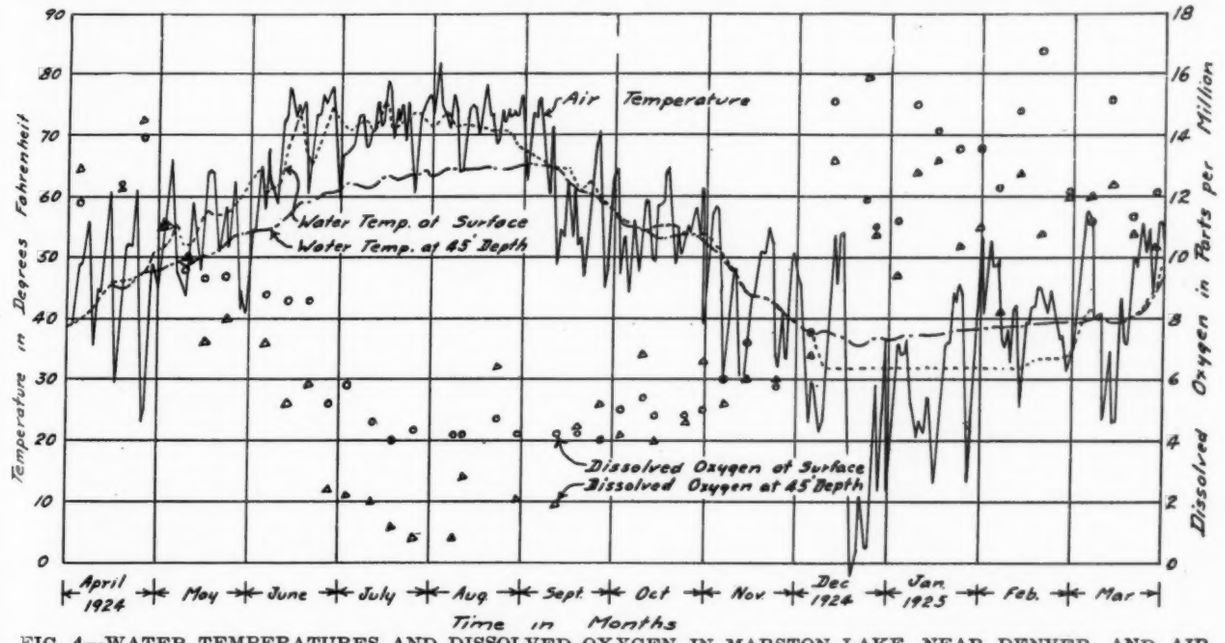


FIG. 4—WATER TEMPERATURES AND DISSOLVED OXYGEN IN MARSTON LAKE, NEAR DENVER, AND AIR TEMPERATURES AT DENVER

effects and from inflow and outflow conditions. The fall period of circulation, "the great overturning" as it is sometimes called, began in September and continued until about the first of December, after which the winter period of stagnation began.

Figure 4 shows the temperatures of Marston Lake water in degrees Fahrenheit and quantities of dissolved oxygen in parts per million, both for depths of 0 and 45 feet, platted as ordinates against dates of observation as abscissas. Mean daily air temperatures at the United States Weather Bureau station in Denver, about ten miles from Marston Lake, are also shown. The different temperature curves offer interesting illustrations of the well known facts that air temperatures are more variable than water temperatures throughout the entire year; that the temperature of the water at the surface of the lake follows very closely the mean curve of air temperature as long as the lake is not covered with ice, and that lake water at the greater depths is colder than the surface water in the summer, and warmer in winter. It will be noticed that during the summer months the mean daily air temperature was sometimes as much as twelve degrees warmer than the surface water, and that the surface water was sometimes as much as twelve degrees warmer than the water at a depth of 45 feet. It will also be noticed that during the winter months the water at a depth of 45 feet was from three to seven degrees warmer than the surface water, the water immediately below the ice of course remaining at the temperature of the freezing point as long as the surface was frozen, while the temperature at a depth of 45 feet was at one time as low as 35 degrees Fahrenheit. During the summer months the extreme maximum temperature of the air was sometimes as much as 17 degrees higher than the temperature of the water at the surface of the lake, while during the winter months the extreme minimum temperature of the air was sometimes as much as 47 degrees lower than the freezing point temperature of the water at the lower surface of the ice covering.

In order to avoid confusion in figure 4, variations in dissolved oxygen content were shown by platting individual observations instead of by drawing curves through the points as was done in the case of the temperature data. Circles were used to represent observations at the surface of the lake, and triangles to represent observations at a depth of 45 feet. The points clearly illustrate the relatively small quantities of dissolved oxygen which exist in the Marston Lake water during the summer months, and the relatively large quantities which are present during the winter months. The number of parts per million are seen to practically double at the time the surface freezes. This holds true for the water at a depth of 45 feet as well as for the water at the surface of the lake. While the observations are somewhat erratic, it will be noticed that the surface water usually contained more dissolved oxygen than the water at the lower level.

Table 2 gives mean air temperatures at Denver and mean water temperatures at different depths in Marston Lake, by months, calculated from the data in Table 1. Mean temperatures for the twelve month period ending March 31, 1925, are also included, these values being noted in the last column of the table. It will be noticed that the monthly mean water temperatures show the same general characteristics as the individual sets of observations platted in figure 3; that is, that the vertical water column had an approximately constant temperature during the spring and fall, that the temperature decreased with the depth below the surface during the summer, and that the temperature increased with the depth during the winter. It is interesting to note that the mean temperature of the water for the twelve month period is practically constant at all depths and almost the same as the mean air temperature.

Table 2—Mean Temperatures of Water in Marston Lake, and of Air at Denver, by Months, for Year Ending March 31, 1925

Kind of data	Depth in feet	Mean Temperatures in Degrees Fahrenheit During Months of												Ave. temp. for year
		Apr. 1924	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec. 1924	Jan. 1925	Feb.	Mar,	
Air Temp.	..	46.0	52.6	68.4	71.8	73.2	60.4	54.4	44.4	25.4	31.4	41.0	44.5	51.1
Water temperatures	0	44.8	55.0	67.8	72.3	71.0	61.6	54.5	46.4	34.7	32.0	32.7	42.4	51.3
	5	43.4	53.8	65.3	70.9	70.2	61.4	54.5	46.3	36.6	36.9	39.4	43.7	51.9
	10	43.4	53.3	63.9	70.5	69.4	60.9	54.1	46.3	37.0	37.2	39.4	43.5	51.6
	15	43.4	52.6	62.2	69.8	69.0	60.8	53.9	46.2	37.2	37.2	39.3	43.4	51.3
	30	44.0	51.2	59.1	66.0	67.2	60.7	53.8	46.2	37.2	37.4	39.4	42.2	50.4
	45	44.1	50.1	58.1	62.9	64.7	60.4	53.8	46.2	37.1	37.7	39.3	41.9	49.7

Street Cleaning Cost Reduced in Toledo

The special assessment levies for street lighting in Toledo, O., have increased from $84,616 in 1922 to $188,076 in 1927, and are set at $205,459 for 1928. At the same time the levies for street cleaning have decreased from $368,473 in 1922 to $302,889 in 1927, and will be only $264,592 in 1928. In giving these figures the Toledo City Journal (published by the Commission of Publicity and Efficiency) explains this by the statement: "Use of machine methods in cleaning streets is probably the chief reason for the decrease."

"In very few cities of the United States is the practice followed of financing these services (street lighting and cleaning) through the levying of special assessments. They have been used in Toledo and a few other Ohio cities in order to procure more money from the general taxes for other governmental services."

Fuel Used by Power Plants

The total amount of electricity produced at public utility power plants in 1926 was 73,791,000,000 k.w.h., according to a statement made public by the

U. S. Geological Survey. Of this total amount, 35½% was generated by water power. Of the 64½% produced by the use of fuel, 90% was generated by the use of coal and the remaining 10% by the use of fuel oil, gas, and wood. Of the total power generated, coal produced 57.7%, oil 3.1%, gas 3.3% and wood 0.4%. The use of fuel oil in generating electricity has declined since 1924, when it reached its maximum, being only 57% as great in 1926 as in 1924, or less than any year since 1918.

The average rate of consumption of the different kinds of fuel in generating electricity were: coal, 1.94 pounds per k.w.h.; oil, 243 k.w.h. per barrel; gas, 22 cubic feet per k.w.h. The best fuel rates for the different fuels were about as follows: coal, 0.9 pounds per k.w.h.; oil, 450 k.w.h. per barrel; gas, 13 cubic feet per k.w.h. These figures show that if all public utility power plants had produced electricity at the best fuel rates, some 40 to 50% of the fuel would have been saved. In the case of coal, this would mean a saving of 20,000,000 tons in 1926, representing a value of about $75,000,000.

The Merchantville-Pensauken Sewage Treatment Plant

Study of operation of a separate sludge digestion plant which has produced excellent results. Air-dried sludge burned readily. Effect of inoculation and removing sludge. Chemical and biological changes. Heat and fertilizer values.

By Michael J. Blew*

The Merchantville-Pensauken sewage treatment plant lies in a valuable residential section on Browning road, a few miles north of Camden, New Jersey. The effluent from this plant passes through a long outfall line discharging into Cooper creek, near Kaighn Avenue bridge. Cooper creek is a semi-tidal stream about thirteen miles long, which has its source in the country near Berlin and enters the Delaware river near the northern boundery of Camden, after traveling a circuitous route through swampy lowlands. Except for a few isolated boat-house colonies, its banks are uninhabited. Near the mouth of the stream is an industrial center where many factories are located.

From water supply reports it is learned that the minimum flow of Cooper creek is about 6,800,000 gallons per day, which is augmented by an average of 40,000,000 gallons per day of fresh water from the tidal prism of the Delaware river. Gaugings taken at Kaighn Avenue bridge gave a flood tide of 18,000,000 gallons and an ebb flow of 24,000,000 gallons. The average down-stream velocity was about 0.42 feet per second in 1923. Movement of water in the stream is rapid enough to prevent the formation of sewage deposits. The creek bed is composed of hard sand and gravel with very little mud and sludge, indicating a rapid scouring action during ebb tide.

In addition to the sewage from the Merchantville-Pensauken plant, Cooper creek receives sewage from Haddonfield, Westmont and Camden, amounting in all to probably about 8,000,000 to 10,000,000 gallons daily.

The present treatment consists of settling and separate sludge digestion, it being concluded that,

*Major, Sanitary Reserve, U. S. A., Philadelphia, Pa.

FIG. 1—SLUDGE DRYING BEDS, MERCHANTVILLE-PENSAUKEN PLANT

for some time to come, plain sedimentation would be sufficient to prevent the causing of a nuisance by discharging the sewage into the creek. In fact, it is doubtful whether any further purification of this sewage would greatly alleviate the condition of the creek, because of the numerous other factors contributing to its pollution.

THE OLD MERCHANTVILLE PLANT

The old Merchantville plant consisted of a septic tank and sand filters, operated by one man working full time. Information concerning it is meager, but it is known that toward the end of its existence it was very objectionable.

There were eight sand beds, most of which were dosed continuously. In some places the beds had broken through at the ventilators, allowing the tank effluent to run untreated through the underdrains into the brook. The distribution was poor, and sewage spread over the beds only after the sand had become clogged near the inlet. Although the beds were rotated every three days, the sand never dried thoroughly because of serious breaks from the secondary tanks, which kept the sand continuously moist. Both the tank effluent and the final effluent were of poor quality. The final effluent had a noticeable odor, and was putrescible.

On some occasions part of the tank effluent was by-passed to the sludge beds, which soon became flooded with sewage, resulting in the discharge of a highly putrescible effluent into the brook. All of the beds in use had a heavy scum over their surface, which was gray to black and very foul. The septic tank was covered and emitted no odors, but the sludge was black and offensive. At times the tank appeared almost solid with scum and sludge.

The sludge was discharged onto sand beds by gravity. Its drying properties were poor and the operation was very odorous. It was evident that some changes must necessarily be made, because conditions were very unsatisfactory and there were many complaints from the neighbors.

About this time the adjoining township of Pensauken decided to install a comprehensive system of sewers with a treatment plant. The consulting engineers, Remington and Vosbury, of Camden, persuaded the two sections to combine their sewage and unite in the construction of a new sewage treatment plant.

THE NEW PLANT

The new plant went into operation in June 1924. It utilized the septic tank from the old plant as a sludge digestion plant, while three new settling tanks were built and equipped with Link-Belt sludge collectors. These tanks are 60 feet long by 12 feet deep by 12 feet wide, and the sludge tank is approximately 55 feet by 40 feet by 11 feet deep.

In order to use all of the old septic tank for sludge digestion, and also prevent the short circuiting of sludge, five wooden partitions were con-

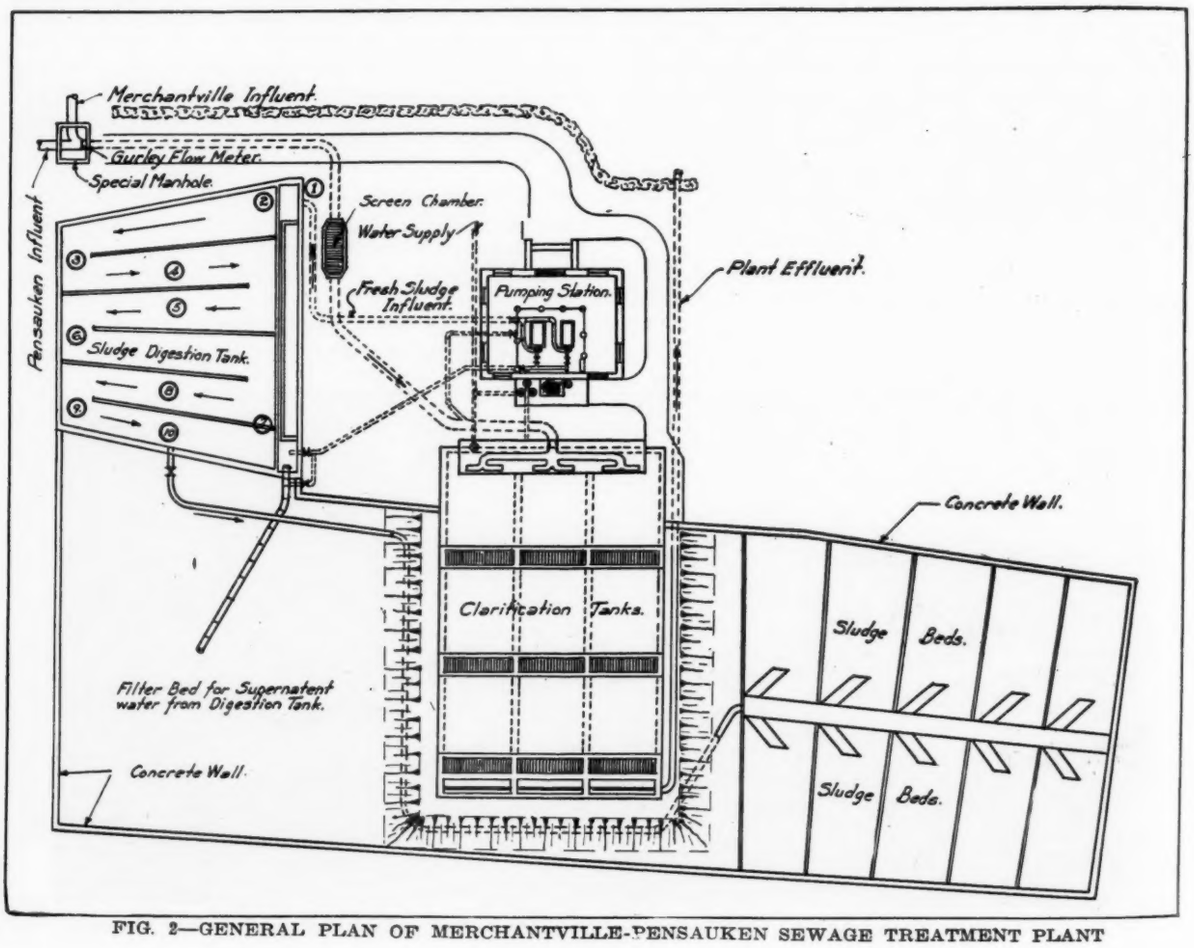


FIG. 2—GENERAL PLAN OF MERCHANTVILLE-PENSAUKEN SEWAGE TREATMENT PLANT

structed, which divided the tank into six channels, resulting in the equivalent of a tank 10 feet deep, 6 feet wide and about 240 feet long, as the sludge must traverse all six sections during its digestion, as shown in the plan of the tank attached. The total volume of the tank is about 20,000 cubic feet. The population contributing to the plant may be estimated conservatively at from 10,000 to 12,000, so that the digestion capacity is a little less than 2 cubic feet per capita. (This plant was described in PUBLIC WORKS for July, 1924.)

The tank was originally provided with manholes in the concrete cover. These were left in place

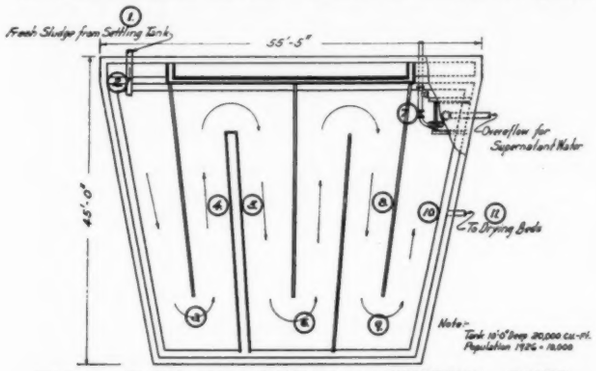


FIG. 3.—PLAN OF SLUDGE DIGESTION TANK. NUMBERS INDICATE POINTS AT WHICH WERE TAKEN SAMPLES REFERRED TO IN THIS ARTICLE.

FIG. 4—COVERED SEPARATE DIGESTION TANK SHOWING MANHOLES THROUGH WHICH SAMPLES WERE TAKEN.

when the tank was remodeled to serve for sludge digestion. By removing these manhole covers, the process of digestion may be observed at various points during the 240 feet of travel, and samples can be collected readily for study. Pump lines were installed so that digested sludge and supernatant water could be circulated and the effect of seeding noted on digestion time. In fact, the set-up is ideal for sludge digestion studies of all kinds.

OPERATION OF THE PLANT

The sludge is scraped to the influent end of the clarification tanks by the Link-Belt collector and deposited into a sump, whence it flows under head into a pump sump, from which it is lifted and deposited into the digestion tank. As the sludge enters the tank, an equivalent quantity of supernatant water is displaced and passes out through a baffle consisting of two-inch planks with one-half-inch slot openings. The supernatant water is piped into a trough and distributed on four sand beds. These beds are used in rotation, each being allowed to dry after use. The accumulated sludge is removed by raking and the bed then placed in condition for use again.

FIG. 5—OPERATING HOUSE

The tank is provided with six four-inch ventilators for the escape of gases. Sometimes in hot summer weather the air currents can be seen passing through the ventilators. The gas is not obnoxious and cannot be detected for more than a few feet from the vent pipes. The temperature of the sludge always remains above the freezing point, but digestion is necessarily retarded during severe winter weather.

The scum in the digestion tank ranges in thickness from about two feet at the inlet end to nothing at the outlet end, where digestion is complete. At the inlet end it is an offensive, gray mass, but at successive points in the tank the color changes to black and the offensive odor is gradually lost. Digestion, as judged from physical appearance, is complete at a point from one-quarter to one-half the distance through the tank.

The digestion tank has foamed only once and the condition was rapidly and completely alleviated by pumping the supernatant from the digested sludge into the foaming section. No lime or other chemical has ever been used.

The final effluent is measured by a Gurley meter over a 29-inch Cipoletti weir. The Merchantville lines are old and a large quantity of infiltration water reaches the plant through them. The Pensauken lines are new and much tighter, but the flow is irregular, because of the pumping stations in Pensauken township. The plant handles from 800,000 to 1,000,000 gallons of sewage daily and discharges a good effluent.

In cleaning a tank, the following procedure is followed: The flow is cut from the tank, and the sludge removed to the pump sump by opening the control valve. The scrapers are then operated for thirty minutes and the sludge again withdrawn. The sludge is allowed to settle in the sump for an hour, and then the pump is

FIG. 6—OVERFLOW WEIR OF SETTLING TANK. ONE TANK OPERATING AND ONE IDLE

started. The discharge is run into the digestion tank until it becomes clear, when it is passed into the other settling tanks. When all the sewage has been removed except the last ten inches, it begins to carry considerable solid matter and is again diverted to the digestion tank. The tank is then cleaned and ready for the sewage flow. This procedure consumes three hours. A back-fill gate is also provided to wash the floor. The total settling capacity is 105,000 gallons; effective settling capacity (two tanks) is 70,000 gallons, and the sewage flow at 2.4 hours detention is about 700,000 gallons per day.

The pumping equipment consists of one 4-inch Dorrco diaphragm pressure pump, and one 4-inch Buffalo centrifugal pump. The diaphragm pump is used but little, as it has been found that the centrifugal handles the sludge and sewage better and much faster. The density of sludge pumped depends on the manipulation of valves from the settling tanks. Ordinarily there seems to be a rapid increase in solid matter in the pump discharge for several minutes, followed by a sharp increase in water and a second increase in solids, which quickly shades off to practically nothing but water. The accumulated sludge is ideal for separate digestion.

SLUDGE DISPOSAL

Digested sludge is discharged onto sand drying beds by gravity. There are ten beds, each about 10

FIG. 7—DIGESTED SLUDGE, AIR-DRIED, BURNING ON SAND BEDS

by 40 feet. Some of the old sand filters are available, in case additional sludge drying space should be required in the future. It is possible to get nine or ten sludge removals from the beds if necessary, but it has been found that six drawings will keep the tank operating satisfactorily at present.

The sludge dries nicely and has every appearance of excellent quality. After drying, it is piled in compost heaps on the sand beds and burned. Some of the sludge burned has contained as much as 60% moisture. A reduction in volume of from 70% to 90% results from the combustion. The resulting ash is of a brick red color and very light and fine, and contains only 1.4 to 1.8% combustible matter. It can be removed from the beds in much less time than the original sludge, and conserves storage space tremendously. It also makes a better and more solid fill in lowlands. A very intense heat is generated in the combustion, reaching from 2000 to 2500 degrees Fahrenheit. All of the sludge from the plant is disposed of in this manner. The odor given off during the process of combustion is not particularly offensive, resembling that of burning

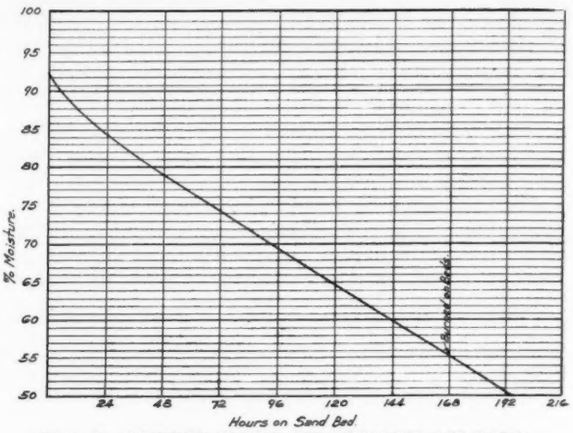


FIG. 8—DRYING RATE OF SLUDGE ON SAND BEDS UNDER FAVORABLE CONDITIONS

Table No. 1—Analyses of Sldge for Digestion Tank, Drawn to Drying Beds

Date	% H_2O	% Ash.	% V.M.	pH.
April, 1926	92.1	51.1	48.9	7.6
" "	91.6	52.2	47.8	7.6
" "	91.2	43.3	56.7	7.6
Feb., 1927	85.3	60.4	39.6	7.6
" "	88.9	54.8	45.2	7.5
" "	89.3	56.5	43.5	7.54
March, 1927	87.5	57.3	42.7	7.6
" "	89.6	55.5	44.5	7.5
" "	88.1	56.4	43.6	7.5
April, 1927	87.5	54.3	45.7	7.6
May, 1927	87.0	54.0	46.0	7.4
June, 1927	81.2	71.6	28.4	7.6
" "	91.9	38.2	61.8	7.4
August, 1927	92.5	55.5	44.5	7.2
" "	90.4	54.8	45.2	7.4

leaf mold or dead grass. It does not travel far, and causes no nuisance. Sludge containing 60% moisture burned as completely as that containing 50% but required more fire to start it and burned for a longer time. The winter sludge burned after about three weeks on the sand beds, while the summer sludge, dried rapidly under the most favorable conditions, burned after a week on the beds.

LABORATORY

A small laboratory has been installed at the plant, from which most of the data were obtained. The Joint Sewage Commission is to be congratulated on the support it has given these studies, both by equipment and encouragement. These tests are being continued.

Standard Methods of Water Analysis of the A. P. H. A. have been used throughout these tests. It has been found best to use glass wool to filter the sludge, before determining pH. The glass wool is placed in a clean six-inch funnel and washed thoroughly with tap water and drained. The funnel is filled with sludge and the first 10 ml. of the

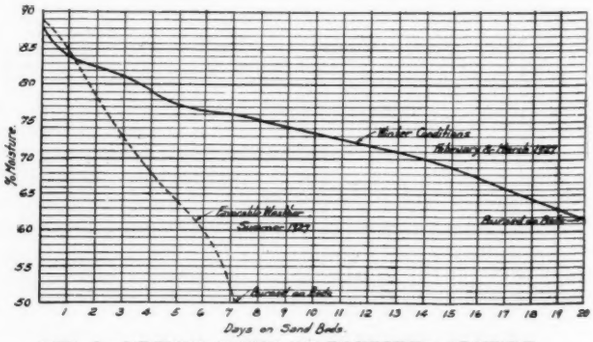


FIG. 9—DRYING RATE OF DIGESTED SLUDGE

filtrate are discarded. After from 20 to 25 ml. have been collected, the pH is determined on a LaMotte Roulette Comparator, with excellent results. Other analyses are according to Sutton or Griffin.

(To be continued)

Well Water Recession in Iowa

A discussion of the samples and tests made of the effects of inoculation and of removing sludge, with a discussion of the results, will be given next month.

A paper with the above title was prepared by James H. Lees, assistant state geologist of Iowa, and presented before the Chicago convention of the American Water Works Association. In this he described the geology of the state as it affects the supply of water to wells, and discussed the lowering of head in wells in different sections of the state and in different strata, with the probable causes. His conclusions from investigations made were as follows:

"I believe that we are justified by the evidence at hand in drawing these conclusions: With regard to the shallow types of wells, dug or bored especially, in general these have become scarcer with the passing years because the supplies of water within their reach have gradually been depleted, partly by increased consumption by animals, by increased transpiration by cultivated crops, by open and closed drains, and partly by increased runoff of rainfall from cultivated areas. However, some parts of the state do not seem to have suffered from this lowering, perhaps because conditions are not so favorable for natural drainage and so the soil water is retained to a greater extent. Driven wells still find plentiful supplies because they are made as a rule in valleys with gravel strewn floors, which are less affected by changing conditions than are upland areas.

"As to drilled wells, those of moderate depth as used on farms or smaller municipalities have gradually been deepened into the lower strata of the drift —many drillers speak of top water in yellow clay and lower water in blue clay, with another horizon in sand at the base of the drift. In parts of the state having thinner drift, drilled wells now enter the stratified rocks, some for a few feet, many for a greater distance. Most wells of this class range in depth between 100 and 200 feet, although some are as deep as 400 and 500 feet. Since these wells draw their supplies from the general body of ground water rather than from the shallower soil water fed by recently fallen rains, their gradual deepening in the wake of the constant lowering of head seems to point rather conclusively toward a real lessening of the amount of water in the ground, owing to both increased demand and decreased supply. In some localities this lowering of head amounts to 20 feet or more during the present century, according to the reports of several drillers, and the total lowering from the time of settlement must be much more than this amount. However, other drillers state that they see little or no difference in ground water conditions while they have been drilling and of course those local factors which affect shallow wells would have some, though less, influence on wells of this type. Again, while shallow wells fluctuate with the seasons and respond quickly to periodic variations in rainfall, deeper wells show much less change from season to season and year to year.

"Finally, as to the deep artesian wells which seek out the great aquifers of the stratified rock series, the evidence so far obtainable seems to be far from conclusive or even consistent. Some of these wells have suffered diminished yields and lowered heads, some of them headed lower from the start than did earlier wells in the same region. But some have higher heads than would be expected from the known factors and a few report higher heads or greater yields than formerly. Unfortunately for purposes of study, these wells are not spaced closely enough for us to say definitely whether or not the general level or the amount of water has receded or remained the same; or, in other words, whether such changes as have occurred are due to local or to widespread causes. Of course, the deeper a well is the greater is the available radius from which it may draw its supply and the greater its chance of surviving drought or draft. Therefore, these deep wells as a class will always have a large assurance of permanence even in the face of the unfavorable factors."

Cast Iron Pipe for Sewers in New Orleans

The soil in New Orleans is all of recent alluvial deposit, varying from almost pure soft clay to pure, very fine sand and mixtures thereof, with many roots and stumps and much peaty matter, in all kinds of irregular stratification. Some of the clay is *very* soft and the sand is almost always impalpably fine. Various samples of soil taken from trenches during excavation have shown a shrinkage on complete drying out of from 30% to 75% of their original volume. Even with good surface drainage, with or without underdrainage, irregular shrinkage and consolidation result under such soil conditions. Sometimes very soft underlying strata exist where excessive vibration is effective to considerable depths under heavy traffic conditions. And there are even indications of local lateral movement of the soil. All of these conditions combine to make the construction and the maintenance of structures carried on or in the soil of that general locality unusually costly and difficult.

These conditions have led to occasional failure of the ordinary forms of sewer pipe construction, owing mainly to irregular settlement after backfilling which caused loosened joints and the gradual penetration of the very fine quicksand into the sewers. In repairing such failures of pipe sewer, the Sewerage and Water Board has used cast-iron pipe with lead joints. According to George G. Earl, general superintendent of the board (to whom we are indebted for this information), this has been found to be successful in holding sewer lines in ground where any other equally cheap form of sewer seems to give eventual trouble. From using cast-iron pipe for replacing lines which have failed, the board has

come gradually to the use of this pipe for original laying of new sewers where they encounter conditions which experience has led them to expect will cause trouble if laid of any other material. Usually it is in the deeper main sewer lines which run from 15″ to 30″ in diameter that such conditions are encountered.

A Rush Paving Job

Work done by force account with simple but efficient equipment—Use of calcium chloride minimizes delay in opening street to traffic.

By Nial Sherwood*

The village of Liberty, N. Y., has just completed a rush paving job on Lincoln Place, which involved about 6,000 square yards of 7-inch concrete pavement, and about 2,000 cubic yards of excavation. The work was done by force account, with village equipment. Calcium chloride was used to reduce the time required for curing the concrete, and traffic was allowed on the street in as little as five days after the concrete was placed.

PLACING AND FINISHING THE CONCRETE

About 2,000 cubic yards of shallow excavation was necessary between the curbs, which were 25 feet apart. A Byers' Bear Cat shovel, with a ½-yard skimmer bucket, was used and on one day moved 300 yards, which was regarded an excellent record considering the shallow cut and the hard digging. Ford trucks were used to haul away the dirt, which was used for fill, the village receiving 10 cents a load for it. Each truck handled about 50 loads a day on the short haul (averaging about one-half mile). The excavation cost averaged 60 cents per yard.

The mix used was 1:2:3½, using local sand of good quality and stone graded according to the specifications of the New York State Highway Department. The concrete was placed 7 inches thick; 42 pounds of 7 x 7 mesh reinforcing was used per 100 square feet, the reinforcing being placed in 10-foot strips. For rapid curing, Solvay calcium chloride was mixed integrally; 200 pounds was mixed with water in a 50-gallon barrel, and 2 quarts added to each one-bag mix. Despite delays due to the excessively rainy weather of late August, the job was finished in about 6 weeks. The use of calcium chloride made it possible to open the street to traffic seven days after finishing, and in some cases in five days. This fact was favorably commented on by the residents.

Using a Rex 7-S mixer equipped with a 10-foot spout, moving was necessary after pouring each 10-foot section, and this was done by means of a Cleveland tractor, as many as thirty moves a day being made. Carey ½ x 7-inch elastic expansion joints were placed at intervals of 40 feet.

The mixing gang consisted of 8 men—1 operator, 1 finisher, 2 men on the float, 2 men placing and spreading, and 2 men charging. Aggregate was placed, practically as needed, by Ford trucks on the finished surface, on the unpaved half of the street, or direct on the subgrade, depending upon circumstances. The street has several sharp bends and some places where work had to be done in close quarters. Dexter, Pennsylvania and Dixie cement was used.

After the initial set had taken place, it was necessary to protect the surface for 24 hours, after which, due to the use of the calcium chloride, no further protection was needed. Burlap was used on this job as a protection for the first 24 hours.

AGGREGATE WAS STORED ON SUBGRADE AT TIMES

Practically all of the equipment used is the property of the village of Liberty, including the Rex mixer, the Cletrac tractor, and the forms.

The cost of the completed job, including 2,000 yards of excavation and 2,200 feet of concrete pavement 25 feet wide, was $20,000, which was $2,000 below the estimate. Edmund Martin was construction superintendent in charge of the work, which was done under the direction and in accordance with the plans of the writer.

*Highway Superintendent, Sullivan County, New York.

Curing Concrete Pavements

The Portland Cement Association in the September issue of its monthly "Concrete Highways" publishes an article calling attention to the importance of the curing of concrete pavements and describing how such curing can best be performed. Concerning the importance, it says that "lack of proper protection during the first 24 hours of curing in hot, dry weather will encourage any tendency to scale or pit and leaves the surface less fit to resist surface wear when the concrete is first opened to traffic.

The proper length of curing period depends to a large extent upon temperature and atmospheric conditions. . . . The use of high-early-strength concrete and calcium chloride as an admixture further reduces the time in which the pavements will attain satisfactory strength. Here again it is most important that during the first 24 hours, at least, when the most rapid hardening is taking place, the pavement be kept properly moist to prevent checking and insure the tough, durable surface demanded for modern vehicle traffic.

"Whatever method of final curing is followed, the initial curing should be obtained with wet burlap or canvass immediately after the last finishing operation is completed. Before the concrete has hardened sufficiently to bear the weight of the final curing material, burlap or canvas strips are laid directly on the surface. The strips should be laid so gently that the surface is not damaged and should be kept constantly wet with fine spray from a hose nozzle. The next morning, or as soon as the concrete will bear the weight of a man, the burlap or canvass may be removed and replaced with the final curing material. Various devices are used to make the handling of the burlap easy and economical.

"After the burlap has been removed the pavement is covered with a thick layer which will retain the moisture. A blanket of earth is a favorite, but hay and straw are equally satisfactory. If an earth covering is used, it should be at least 2 inches thick and retentive of moisture. Stone or hard lumps have no value as curing agents. Sand is good, but drys so rapidly that it requires more frequent sprinkling than earth. Hay and straw are economical covering materials. They absorb moisture readily and retain it so well that they require less sprinkling than earth covering. Hay or straw should cover all parts of the pavement to a depth of 6 inches.

"No matter what material is put on, its effectiveness depends on its being kept moist. Wetting is usually continued for a period of from 7 to 21 days, depending upon the rapidity with which the pavement hardens. In city work it is often more economical to sprinkle concrete than to cover it. This sprinkling should be accomplished by mechanical devices which throws a fine spray continuously over the entire pavement. Intermittent sprinkling with a hose will not develop the full strength of the concrete. On flat grades, curing is often effected by covering the concrete with ponds of water held in place by earth dams. This is most satisfactory except on gumbo soils, where escaping water may cause subgrade swelling."

Photography for Engineers

Properly made photographs are valuable for illustrating and recording important points in engineering works. Types of cameras best suited to general engineering photography and points to be observed in taking pictures.

The Bridge Instruction Manual of the California State Highway Department contains the following provisions:

"A photographic record of all stages and details of the construction of all structures is desired. This record is to be complete, taking in the site before construction is started, all details of construction, including methods, plant, etc., details of the finished structure and views of the completed contract.

"All negatives and the prints desired by the Bridge Department will be paid for by the Bridge Department and become the property of the state.

"The Resident Engineer will have the films developed and submit them to the office as soon as possible. The films shall be numbered consecutively through the progress of the work in the lower left hand corner, and . . . shall be accompanied by a form containing the number of the film, brief description of the photograph, date, etc.

"The cost of films and their developing will be taken care of in the Resident Engineer's expense account."

Photographic records are coming more and more into use in engineering. In construction they are used to record the progress of the work and the methods of construction, and also to make records of the materials used, as described in PUBLIC WORKS for April, 1927. As records in case of litigation, photographs may be invaluable, when properly dated and identified. The use of the camera in mapping is gaining steadily; there is an increasing wide recognition of aerial maps, and their many uses. (See PUBLIC WORKS, p. 216, June, 1927.) Good photographs are invaluable in illustrating points in construction and design for engineering papers or articles. They also make an excellent private record for the engineer of the work on which he has been engaged.

A good picture or illustration attracts attention. A well-illustrated article in a magazine is more apt to be read and is read with more attention and appreciation than an equally good article without illustrations. The percentage of sleepers is less in an illustrated lecture, even though the subject be a dry one—provided, of course, that in both magazine and lecture the pictures are clear and really show something.

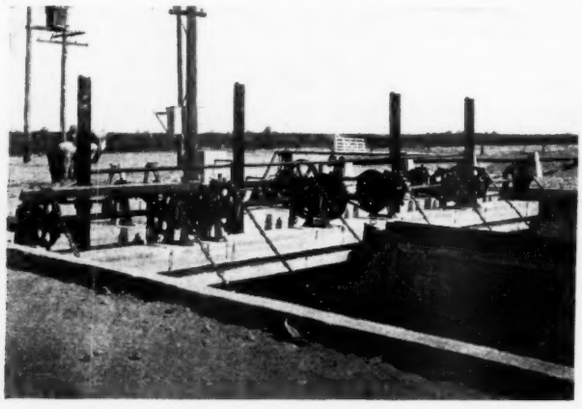
There are three important features of picture making which must be considered if a reasonable number of the pictures are to be successful. These are: A proper camera; an acquaintance with the technique of picture making; knowing what to take. Of the three, the last is perhaps the most important. A good photographer often turns in worthless construction pictures because he does not know what should be given prominence in the picture, and what should be omitted or made of secondary importance.

THE CAMERA

There are numerous cameras on the market, of many sizes, and at various prices. For the average

POOR SELECTION OF SUBJECT. SHOWS NOTHING IN PARTICULAR.

EXCELLENT FOR THE PURPOSE INTENDED, WHICH WAS TO SHOW POOR QUALITY OF ROCK, WHICH CRUSHED UNDER ROLLER.

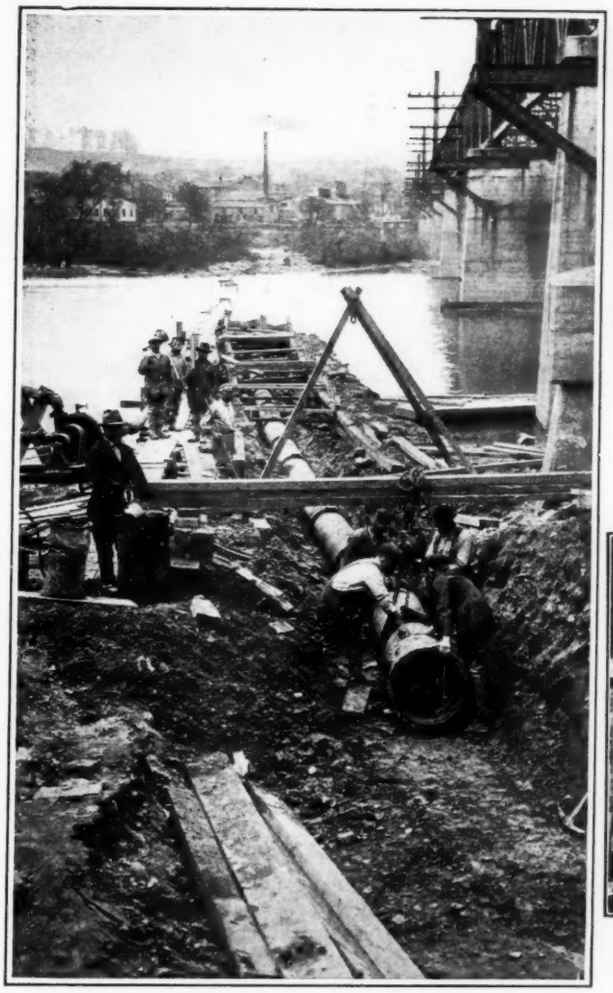


SHOWS CLEARLY THE ESSENTIAL FEATURES OF ONE TYPE OF SLUDGE COLLECTOR.

THIS ILLUSTRATION SHOWS ONE METHOD OF BRINGING OUT CERTAIN FEATURES OF A PAVEMENT.

AN EXCELLENT CONSTRUCTION PICTURE. BETTER IF MEN HAD NOT POSED.

ILLUSTRATIONS OF SELECTION OF WHAT TO TAKE: STUDY YOUR LAYOUT; DECIDE WHAT YOU WANT TO SHOW; GET CLOSE ENOUGH TO THE PICTURE TO BRING OUT THE IMPORTANT FEATURES; EXCLUDE UNIMPORTANT DETAILS FROM THE FOREGROUND.



COMPLIES WITH MOST OF THE REQUIREMENTS FOR A GOOD CONSTRUCTION PICTURE.

ABOVE: SHOWS CLEARLY EFFECT OF TOO MUCH FILLER. BELOW: THE PICTURE TELLS JUST HOW IT IS DONE

HOW TO TAKE IT

GOOD FOCUS; SUN BEHIND THE CAMERA (OR NEARLY SO); GOOD LIGHT AND GOOD TIMING ARE BASIC ESSENTIALS OF A GOOD PICTURE.

GOOD. SHOWS METHOD OF WORK, EQUIPMENT USED AND NECESSARY DETAIL. MEN NOT POSING.

engineer the best, most economical and most useful camera is the 3¼x5½ folding camera with a 7.7 lens. This camera is neither too large nor too heavy for convenient transportation and handling. The 7.7 lens is fast enough and clear enough for good pictures; for those who want something better, the same camera with 6.3 lens is 50 per cent faster, and will do somewhat better work where light conditions are not so favorable. The 3¼x5½ camera with 7.7 lens costs about $30; with the 6.3 lens about $50.

The California Bridge Manual, referred to above, states in regard to size:

"Post card size (3¼ x 5½) photographs are most desirable for filing and are of sufficient size to show what is desired. As uniformity of records is to be striven for, the Resident Engineer is expected to submit photographs of this size."

Where a small camera, easier to handle and carry, is desired, a 2¼ x 3¼ folding film camera may be used, and the pictures enlarged. For this service, a lens of the same speed, or a little faster, is desirable. The smaller camera costs somewhat less to purchase and about half as much to operate. But for most uses it will not be so satisfactory to the engineer for strictly engineering work.

Larger cameras, such as the 5x7, 6x8, and 8x10, are excellent and should be used wherever possible for record work and official photographs. However, they are not so suitable for the engineer; for they are bulky, heavy, not so fast, and cost a great deal to operate, and for more or less informal pictures to illustrate details of the work, for the engineer's private records are not so satisfactory as the smaller cameras.

Perhaps the best camera of all for construction use is the Graflex, but it has two distinct disadvantages—cost, and weight and bulk. It is much heavier than the folding cameras, and it does not fold up so compactly. Graflex cameras are very fast, taking pictures under favorable conditions to 1/1000 of a second, and they allow the subject to be viewed in the same size and as it will appear in the picture up to the instant of exposure. Better pictures are secured almost invariably as a result of this feature.

TECHNIQUE OF TAKING PICTURES

It is not possible here to tell much about the technique of picture taking. As a rule, in taking engineering pictures not so much attention need be given to the artistic point of view, though this should never be overlooked.

Except in the glaring sunlight of the tropics, it is usually desirable to take photographs in sunlight, and as near noon as possible, since the light is more brilliant at that time. In the summer, pictures may be taken best between 9 A. M. and 3 P. M., occasionally a little later; in the winter, between 10 A. M. and 2 P. M. Winter pictures nearly always lack the brilliancy of summer pictures; and the uniform glare of snow gives a flatness which is difficult to obviate.

While the object photographed should generally be in the sun, an experienced photographer often may find it advantageous to do the reverse; for instance, if the outline or silhouette is desired, the sun may be in front of the photographer, the camera being properly shaded. Every problem must be considered by itself, but the beginner in photography will find it wiser to stick to elementary rules, of which a basic one is that the object to be photographed should be in the sunlight, and the sun be behind the camera, or nearly so. (Having the sun at an angle of 45° so the shadows can be seen may help to bring out the details).

Timing and shutter stops or aperture openings are very important; mostly they must be learned by experience. In the absence of other data, 1/25 of a second and a 16 stop or opening will give good results on a bright day day for all snaps or instantaneous work not involving rapidly moving objects. An 8 or 11 stop may be used on a dull day.

On the better cameras the "f" system of stops or apertures is used, and the amount of light admitted varies inversely as the square of the stop used. Thus, a lens using a stop of 8 would let in 4 times as much light as one using a stop of 16, or $(1/16)^2$: $(1/8)^2$=1:4.

The relation between the speed or time required and the shutter opening can be computed, starting with the basic ratio of 1/25 second and 16 stop for a bright day. Thus, for a given light condition, an 8 stop will require about 1/100 of a second where a 16 stop would require a 1/25 second.

Focus is very important, for a blurred picture will not show details. Blurring may also be caused by holding the camera unsteadily, or during exposures longer than 1/25 second or by improper or inexact focusing. It is preferable to use as small a stop as possible (16 or 22), as the smaller the stop the sharper the definition.

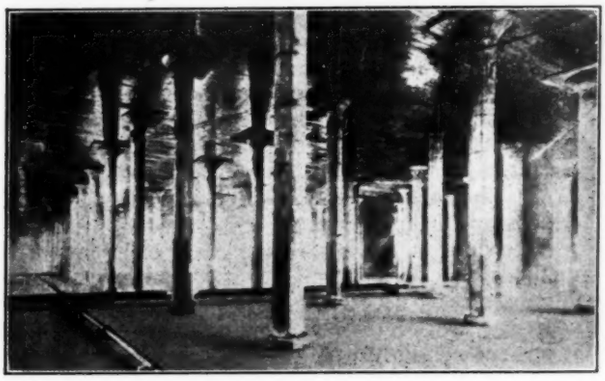
Tables of time required for exposures under varying conditions of light are available, as are exposure meters, both of which are very valuable in securing correct timing of exposures. The camera should be held level, and the lens shielded when pointed toward the sun. The exposed film should be replaced with a new one immediately after taking, or double exposures will sometimes occur.

WHAT TO TAKE

Perhaps the first rule is to keep unimportant details out of the foreground and give the most important objects the most prominent place. In connection with this, a background is necessary which will set off the object photographed. A background of the same general color value or composition as the object to be photographed, or one into which the object blends, should be avoided . The sky as a background is objectionable unless only an outline of the object is desired.

It is nearly or quite as important to remember that one picture will rarely show every thing, and in few cases will a point blank shot get very much. A study is necessary to determine just what it is desired to show, and the pictures taken should be the result of this study. Frequently a succession of pictures showing related details or processes will illustrate what is wanted, when a picture of the whole would be disappointing. Thought and study and a definite idea of just what is wanted are as essential to the production of a good photograph as to a good engineering structure.

Some advice on how to make successful construction pictures was given in the August, 1927, issue of the *Highway News* from which the following is extracted:



"A photograph of a stationary subject, such as a section of road or a culvert, may fulfill or fail its purpose, according to where the camera man stood. General views of highways would be improved if taken from an elevated position, such as from the seat of a truck or even higher. The best place to stand is over the shoulder or near the edge of the pavement, facing the direction of traffic.

"Different viewpoints serve to emphasize different facts about the same thing. For instance, one view of a culvert, from the roadway, will show its relation to traffic; another will show its reaction to the stream or ditch; a third might show its position with respect to the drainage area. A fourth will show details of construction and its material condition.

"While the picture as a whole conveys impressions, it is the details that are usually most valuable to the engineer. Therefore, how best to catch these details is worth some experimenting. Along with general views of a bridge, for example, a set of views showing such details as pavement, railing and expansion joints, is desirable, as are views showing cracks, warping, disintegration, undermining, or some other process of deterioration. The details tell the story; so learn to get close to them, but not so close as to exclude surrounding means of identification.

"Pictures of roadway structures taken to show examples of good construction are best without the distracting influences of traffic. However, photographs taken to show roads or construction methods and equipment require the element of action. One of the most difficult tasks of the photographer is to get workmen in construction scenes to work, apparently unconscious to the eye of the camera. A successful little trick here is to approach the job keeping the camera closed or out of sight and then snap the picture without warning when the opportunity occurs.

"With vehicles, a road scene becomes more than just that; it may present a case for greater width and additional traffic lanes, a restriction of loads, or

POOR RESULTS

ABOVE: WHAT REFLECTION AND REFRACTION OF LIGHT WILL DO. AT THE RIGHT: OBJECTIVE INDISTINCT; IMPOSSIBLE TO TELL WHAT PICTURE IS MEANT TO SHOW. BELOW: SUBJECT UNINTERESTING; POOR LIGHTING IS TYPICAL OF WINTER PICTURES.

Outdoor Exposure Table

Applies to sunny days, 2½ hours after sunrise until 2½ hours before sunset.

Subject	Rectilinear, Anastigmat or Kodar Lens Cameras			Single Lens Folding Cameras		Fixed Focus Box Cameras
	Shutter Speed	Stop Recti-linear	Stop Kodar or Anastigmat	Shutter Speed	Stop	
Snow, water, distant landscapes	1/25	32	f. 22	1/25	3	Snapshot, Second Stop
Ordinary landscapes, showing sky, principal object in foreground	1/25	16	16	1/25	2	Snapshot, Largest Stop
Groups; street scenes; nearby landscapes with little or no sky	1/25	8	11	1/25	1	Snapshot, Largest Stop
In shade; portraits with good light	1/25	4	8	1 Second	4	1 Second, Third Stop

On a bright-cloudy day, use exposure two to three times as long; on dull day, four to eight times as long.

a change in some regulation. Many good attempts at traffic scenes have fallen short by 'posing' the vehicles. If driverless, or headed toward one side, they are obviously posed and make the whole scene artificial. Moving objects can rarely be photographed sharply while crossing the range of the camera unless the instrument has an unusually fast lens and shutter.

"Composition applies to practical engineering photographs as well as to artistic work. Just as a logical, well-organized and concise technical report gets its message over more accurately and effectively than a muddled report, so a well composed photograph is more valuable than one with a jumble of unimportant or misleading details."

A record should be made of every exposure. This may be done on the attachment provided with some cameras, but space there is limited, and it is more desirable to have a section in the note book reserved for data of this kind. In addition to the record as to the subject matter of the picture, it is very desirable that additional information be set down regarding the date, hour, weather conditions, (as dull, cloudy, or bright), the time and aperature used, and such other data as may aid in determining the reasons for the success or failure of the photograph.

Financing Public Improvements by Special Assessments

By Raymond E. Duff, C.E.*

One of the first methods used to raise funds for public works was to levy a tax on all real and personal property. This has the disadvantage that it immediately increases the general taxes. It can easily be seen, therefore, that cities often cannot undertake a number of major (or minor) improvements because of limitations by law or the refusal of the people to pass a required bond issue. It was realized that all property in a village or city does not receive the same benefit from an improvement. Therefore, the method of levying all or part of the cost of a project upon the specially benefited property was adopted. But the cities of the country have been slow to realize the full possibilities of this plan.

In certain types of public improvements where it is necessary to purchase property, a third method —excess condemnation—is sometimes used. It is not practical to attempt to apply this plan in the State of Ohio, because it is difficult to sell the bonds, which are a *"lien only against the property so acquired."* (State Constitution, article 18, section 10).

A list of the more important improvements which can be financed by special assessments is given below:

Street openings; street widenings; street paving; parks and boulevards; civic centers; sewer systems; water systems; viaducts; tunnels; bridges; elimination of grade crossings; rapid-transit lines; and water front developments.

In order to be upheld by the courts of most states a special assessment must meet certain requirements:

(1) The use for which the money is raised must be public.

(2) The improvement for which the assessment is levied must beneficially affect a well defined and limited area.

(3) The assessment must not exceed the actual benefit to each parcel assessed.

(4) The owner of the land assessed must be given an opportunity for a hearing on the extent of the benefit.

(5) The total assessment (final) must not exceed the cost of the imrovement.

According to the law of the State of Ohio, three methods may be used in levying special assessments. The first is by a percentage of the tax value of the property assessed. This plan is very unjust, and is no true measure of the benefit received. The second method is by the front-foot of the property bounding and abutting upon the improvement. The use of this system is limited, and depends on the location, shape, and similarity of the various parcels of property assessed. It cannot be used in taxing districts. It was recently declared invalid by the U. S. Court of Appeals in the District of Columbia in the case of William G. Johnson and others vs. Commissioners of the District of Columbia. (Case No. 4388—See *Public Works* for February, 1927.) The third is in proportion to the benefits that may result from the improvement. In the writer's opinion, this is the only proper method to use because *a special assessment is in the nature of a tax upon property levied according to benefits conferred on the property.* (Cooley on Taxation.)

It can be seen, therefore, that determining the amount and extent of the benefit becomes the heart of the whole problem. It must first be decided what portion of the cost of the improvement will be paid by the city at large. This is termed the general benefit. If there is a tendency to exaggerate the general benefit, it imposes an undue burden upon the many, and confers an undue benefit upon the few. Too often a city has followed this course because it appeared to be the course of least resistance. Therefore, in the face of increasing taxes, it has been necessary to find a more equitable plan of financing projects. This is especially true where the property abutting upon the improvement is not the only property in the immediate vicinity that receives a material benefit. This benefit which affects a limited area is called the special benefit.

The problem now remains to actually levy the assessments on the various parcels of property. It is here, perhaps, that the greatest difficulty is encountered. It has been a common rule in this country in the case of ordinary improvements such as sewers, water mains, and pavements, to assess the abutting property so much a front-foot. That this method is often unjust is best proven by referring to the case in the District of Columbia which was mentioned in a previous paragraph. It may occur that property located anywhere from five to one hundred feet from the street, does not abut on the street and therefore cannot be assessed. Also, it may be true that some parcels are of a very irregular shape. In order to overcome this difficulty the writer contends that from a theoretical standpoint, all assessments should be district assessments. Lines should be drawn defining the district of special benefit. All property within this district that receives a benefit should be assessed.

*Appraiser of Benefits on Public Improvements, Cleveland, O.

This does not mean that it is always necessary to describe a taxing district in the legislation in connection with the improvement. On ordinary work the City of Cleveland has amended part of its legislation to read as follows:

". . . cost . . . shall be assessed upon all the lots and lands abutting upon, and *other specially benefited property adjacent to*———— *from*———— *to* ———— in proportion to the benefits which may result from said improvement,. . . "

In making the assessments, no set of rules can be drawn that will apply in each case because of the different problems presented even in two improvements of the same type. Also, improvements of unlike character are assessed in different ways. The laws of the different states also limit the power to assess property in various ways.

The experience of the writer forces him to the conclusion that the best method of financing public improvements is by special assessments, because, if they are properly applied, they are very equitable and because they are applicable to all types of projects. An exceptional example is the financing of the Moffat Tunnel, which is being built through the Rocky Mountains in the West.

Portland Cement Production

The Department of Commerce now includes each month in the statistics of the cement industry a figure showing the ratio of production to total capacity, and the operation ratio, production, shipments and stocks on hand hereafter will be made public monthly.

The statement for the month of September, 1927, establishes the total capacity of the cement industry, as of September 30 last, at 229,020,000 barrels. The capacity, established by rates of production sustained over continuous periods of three months by each of the plants, indicates an increase by construction of new plants and extensions of old ones from a total capacity for the year 1926 of at least 215,300,000 barrels. On the basis of these revised estimates, the 1926 production amounted to 76.4 percent of capacity.

The August, 1927, output represented approximately 94.4 percent of the capacity of the plants for that month, and the September output 92.2 percent; while the production for the first eight months of the year was 75.2 percent of the capacity available during that period, and for the first nine months 77.2 percent.

Light Asphaltic Oil Road Surfaces

Abstract of report made by California Department of Public Works cooperating with Bureau of Public Roads, on use of light asphaltic oil in road treatment on the Pacific Coast. Report prepared by C. L. McKesson, materials and research engineer of the California Department, and W. N. Frickstad, highway engineer of the U. S. Bureau of Public Roads

In all states the problem of developing satisfactory types of surface for light-traffic roads is an important one because of the large mileage of such roads in the county and local systems, and even in the systems that are set apart for improvement by the States.

In the western states the need for such types of construction is felt, perhaps more sharply than in other sections, not only because of the somewhat more extensive mileage on which traffic is now and will remain light, but also because similar forms of construction are needed for the initial improvement of a very considerable mileage upon which a rapid increase of traffic is expected. On roads of the latter class the inexpensive surface is regarded as merely a first stage of improvement, to be replaced as traffic demands and funds become available; but for the present the problem is one of improving the service of such roads at minimum expense in order that the benefit may be quickly and widely distributed over a large mileage.

To meet this need the states of the West have built in recent years many miles of traffic-bound metaled roads, the surfacing material of which is finely crushed rock or gravel. Differing from waterbound macadam in several aspects, this type has practically supplanted true macadam because it is less expensive in first cost and more readily maintained under traffic. However, such surfaces wear rapidly under traffic, and highway authorities are becoming seriously concerned at the mounting cost of renewing the road metal. Also, the dust nuisance is very annoying, costly and even dangerous, and the cost of operating vehicles upon these surfaces is rather high.

Recognizing the objectionable features of present practices, and convinced of the necessity of developing satisfactory types of highway surfacing intermediate between ordinary gravel and sand-clay and the expensive pavement types, and having in mind, especially, the need of such types in the western states, the United States Bureau of Public Roads and the California Highway Commission, in 1926, undertook the cooperative investigation of which the preliminary findings are presented in this report.

The particular purposes of the investigation were to determine the service value that may be expected of fine crushed rock and gravel surfaces; to ascertain what methods might be employed to conserve material and increase serviceability by the use of bituminous material; and to study their value as bases for higher types of less cost than the plant-mixed surfaces. Rather than undertake experimental construction, it was hoped the solution would be found in an examination and analysis of surfaces already existing.

The first effort upon inauguration of the study was the accumulation of data regarding successful and unsuccessful examples of the respective types; records of processes and materials; cost data; weather and soil information; service history, and maintenance methods and costs. These examples were found to fall within three natural groups:

1. Untreated surface, generally of the fine crushed rock or gravel type.
2. Roadway, either natural soil or metaled, treated with "light" or "fuel" asphaltic oil, material which can be applied at atmospheric temperature or by gentle warming.
3. Metaled roadways treated with "road" oil or with soft grades of asphalt.

The multiplicity of roadway types within the field of the study, even when limited to the western states, has made clear that much time will be required to complete the work undertaken. In the meantime, the disadvantages of untreated surfaces have become all too apparent and everywhere there is a desire to find the remedy at the earliest possible date. Many experiments are being undertaken, some of which repeat methods discarded elsewhere. Therefore a progress report has been prepared for publication by the California Division of Highways, and the essential portions of this report are reproduced in this article. This is done to make immediately available to highway authorities certain information that has been gathered as to the use of "light" asphaltic oil residuum in the two Pacific coast states of Oregon and California. Field, office, and laboratory data pertaining to the second group of examples above mentioned are presented and discussed; and sufficient data pertaining to the first group, "Untreated surfaces," are included to tie the main subject to the present construction and maintenance situation.

Although "road" oils and soft asphalts overlap the field of "fuel" oil, and some mention thereof will necessarily find its way into this progress report, the use of the former has not been examined sufficiently to warrant presentation at this time. The study of surface treatments with the heavier asphaltic products, and the possibility of utilizing existing crushed rock and gravel surfaces as bases for bituminous macadam construction, are the purposes of the extension of the investigation. Consequently, no general conclusions as to relative utility of types are yet formulated. Such conclusions as are here presented relate to the scope of this progress report only.

FINE CRUSHED ROCK AND GRAVEL SURFACES

As commonly constructed, the fine crushed rock and gravel surfaces are built in two courses to a total thickness of about 6 inches. The maximum size of the base stone is approximately 1½ inches and that of the top course, 1 inch or ¾ inch. Crusher-run material is used for both courses—often with an admixture of clay or other binder—and both courses are compacted under traffic, the construction trucking being utilized as much as possible for this purpose.

Such surfaces are maintained by frequent blading or dragging or by a combination of the two. Ideally, there should be maintained on the surface of the road a light mulch, consisting of about half an inch of loose fine material to protect the compacted metal beneath; and the constant working of this fine material across the surface has been found effective as a means of preventing the formation of pits and corrugations.

Intended for light traffic, and serving best where the traffic does not exceed 300 vehicles per day, these roads can usually be kept smooth at a yearly cost of about $1 per mile for each unit of average daily traffic. For example, a road carrying an average traffic of 300 vehicles per day can be kept smooth at a cost of about $300 per mile per year.

This, however, does not include the cost of replacing the material worn from the surface by the traffic, a loss which is very considerable, and which, with the accompanying dust nuisance, is perhaps the most serious objection to the types. Estimating from the interval between resurfacing operations and the amount of metal added, reports received indicate that from 1 to 1½ inches of metal will be removed in a year by a traffic of 500 vehicles a day. It is possible that these are extreme cases, and that the heavy loss indicated is the result of imperfect compacting or the use of inferior material; but even if the estimates be heavily discounted, and the loss be assumed to average no more than three-fourths inch of compacted material a year, the annual cost of replacement, at $2.50 per cubic yard, loose measurement, will be $750 a mile of 18-foot surface. Adding to this the $500 per mile required for ordinary maintenance, the total annual cost of upkeep for an 18-foot roadway, carrying 500 vehicles a day, is found to be no less than $1,250 a mile; and this is a conservative figure, as indicated by the detailed cost data to be found elsewhere in this report.

The other objections that have been raised against the type are, (1) that the tractive resistance of the surface is high, and (2) that it causes heavy tire wear.

Recognizing these defects, the Oregon State Highway Commission, in 1923, conducted experiments with a view to developing methods of treating the fine crushed metal with bituminous materials to improve its service and reduce the heavy loss by attrition; and the successful use in these experiments of a light asphaltic residual oil, known locally as "fuel oil," led to the use of the material for the treatment of several hundred miles by the commission in 1924, 1925, and 1926.

Impressed by the Oregon experience, the California Division of Highways conducted similar experiments in 1925, which were followed by the oiling of 190 miles of State highway in 1926, and by the scheduling of about 700 miles for oiling in 1927; and the Washington and Idaho State Highway Departments also treated experimental sections in 1926, using methods adapted from Oregon practice.

OIL TREATMENT OF FINE CRUSHED ROCK AND GRAVEL ROADS

Two general methods of treatment have been developed, which may be described, respectively, as the method of surface treatment, and the method of surface mixing. These are briefly described as follows:

Surface treatment method.—This treatment as practiced in Oregon and California contemplates the impregnation of the upper portion of a compacted fine crushed rock or gravel road with light asphaltic oil. The process resembles the ordinary surface treatment of macadam when light oils or tars are used, but differs from surface treatments with heavy oils in that there is no formation of a distinct mat of stone, chips, and binder. For practical reasons, some cover material is commonly used, but the amount is usually limited, and the light oil so penetrates the road crust that there is finally little left on the surface to be absorbed by the application of chips.

The first step in this process is the thorough sweeping of the existing road surface with a power broom, supplemented by hand brooming if necessary, to remove all loose material and scales of fines and expose the compacted rock surface. The light oil is then applied under pressure at the rate of about three-tenths of a gallon per square yard and allowed to penetrate, the time required depending upon the texture of the surface and the viscosity of the oil. Usually two or three days is sufficient, during which time the road is closed to traffic if practicable. At this stage in Oregon small imperfections in the surface are repaired with a lean mixture of oil and aggregate.

When the first application of oil has thoroughly penetrated, a second is spread at the rate of about two-tenths of a gallon per square yard, and, as before, is allowed to stand for several days without traffic if possible, while the oil is being partially absorbed. The treatment is completed by spreading stone chips over the surface before the road is opened to traffic, and, if vehicles can not longer be kept off, the chips are spread immediately after the second application of oil. The quantity of cover material usually used ranges from 10 to 25 pounds per square yard, depending upon the viscosity of the oil and whether or not the road is to be opened to traffic immediately. The larger amount is necessary if the road is to be opened immediately; and oils of high viscosity require more cover than the thinner oils.

There is a tendency in some places to modify the surface treatment method described by substituting heavy road oil. As before stated, no recommendations have yet been formulated on this subject. It should be pointed out, however, that heavy road oil is more costly than "fuel oil," demands more equipment and better technic in application, and requires from 100 to 200 cubic yards per mile of screenings for cover.

Surface mixing method.—In the method of surface mixing, the surface of the previously constructed fine crushed rock or gravel road is first scarified to a uniform depth of 1½ to3 inches according to the thickness of bituminous surface desired. The light asphaltic residual oil is then applied in two or three applications, each consisting usually of about one-half gallon per square yard; and after each application the oil and loose stone are partially mixed with a disk cultivator or spring-tooth harrow, or both. The material is then bladed repeatedly into windrows and respread until a uniform color is attained. It is finally spread to the desired crown and the road is then opened and continually dragged or bladed while it is being compacted by the traffic. (This method as practiced in California was described in the October issue of Public Works.)

Roads treated by these methods are of distinctive type and are not to be confused with roads treated for dust palliative purposes. In appearance they resemble other asphaltic surfaces. Skillfully prepared and treated, their smoothness shortly after completion, as indicated by "roughometer" readings, is equal to that of the best pavements. When well maintained, they appear to rate with good bituminous macadam; but, at their worst, when maintenance is neglected or when the surfacing material or its condition at the time of treatment is poor, they may become intolerably rough. There is no dust, and tractive resistance and tire wear are both low.

CONCLUSIONS

Although the investigation so far has been limited territorially and in subject matter as already stated, progress has been sufficient to justify a number of conclusions, particularly with reference to the economy of the light oil treatments for fine crushed rock and gravel roads, and the essential features of the construction methods. These, which are set forth below, are based principally upon data gathered in Oregon and California, but the climate, topography, soil, traffic, and costs vary so widely in the two states that the observations have a rather wide application.

The principal conclusions are as follows:

1. Light asphaltic residual treatments as practiced in Oregon and California have demonstrated their utility in the preservation of existing metaled road surfaces, and are justified in places where the cost of the oil is not prohibitive.

2. Oil treatment has substantially reduced maintenance and replacement charges on fine crushed rock and gravel roads in Oregon and California. The first cost is frequently less than the value of the metal lost yearly from the same road before treatment. Maintenance after oiling will probably not exceed the cost of adequate maintenance of the untreated surface, exclusive of the replacement of metal.

3. Oil treatment improves service and is, therefore, popular with the public. It eliminates dust, increases smoothness, decreases tire wear, and lowers fuel consumption.

4. Any road in Oregon or California which has justified improvement with a fine crushed rock or gravel surface warrants the additional ex-

pense of a light oil treatment, except possibly in rare instances of isolation, extraordinarily cheap material supply, or low service requirements. Direct financial justification will generally follow a comparison of the estimated maintenance after treatment plus a reasonable annual portion of the oiling cost with the known maintenance cost prior to oiling plus the value of untreated metal destroyed annually.

5. An efficient maintenance organization is essential to the success of light oil treatments. Maintenance must be immediate and continuous, otherwise oiling will be unsuccessful and should not be undertaken. While proper maintenance is stressed as a prime requisite, the total annual cost is less than that of untreated roads.

6. The recorded success with light oils should not stop continued development of present practices or experimentation with heavy asphalts. However, the most that can be expected of the latter is some further reduction of annual costs, particular where traffic is heavy, and that possibility can not justify failure to accept and use present methods until or unless better are developed.

7. In the matter of new construction no conclusions can yet be formulated as to the relative merits of building fine crushed rock or gravel surfaces, to be immediately oil-treated, or of adopting some form of bituminous macadam.

8. Protection of vehicles from freshly applied oil is indispensable; otherwise, damage to traffic may more than offset the benefits resulting from treatment.

9. Examples of oil-treated natural soil roads furnish impressive figures of good service and low costs. This type has a larger field than has heretofore been realized where soil, climate and traffic are favorable. It deserves more scientific study and active consideration.

10. *Precautions.*—The immediate improvement that generally follows oil treatment has sometimes encouraged a feeling that almost any road may be successfully treated by almost any method. Subsequent complete or partial failure has discredited the process. The facts are that success will be proportionate to the suitability of physical conditions, intelligence of supervision, and skillfulness of workmanship. The following are important precautions to be observed.

(*a*) Unless there is a maintenance organization accustomed to giving daily attention to necessary repairs, oiling should not be undertaken. Delay and neglect cause rapid destruction and discredit the process with the public which expects more of an oiled than of an untreated road. The success in Oregon which has led to renewed interest in the whole subject was due in large measure to the prior development of an efficient maintenance organization.

(*b*) There must be sufficient thickness of metal to carry the expected traffic.

(*c*) The width of the stone surfacing should be adequate—rarely less than 18 feet. Vehicles turning on and off the oiled surfaces tend to crumble the edges.

(*d*) The metal must be compacted completely from top to bottom if the method of surface treatment is to be used, and at least through the untreated base if the surface-mixing method is to be followed. A layer of loose material between base and mixed top may cause rutting, shoving, or breaking.

(*e*) For surface treatment, repairs should be completed and the road compacted well in advance of oiling. Spots escaping attention should be repaired between applications of oil.

(*f*) All loose material and scales of fines must be removed before the oil is applied to the surface. Sweeping must expose clean rock or gravel firmly embedded.

(*g*) The texture of the stone surface should be uniform. Results of surface treatment will be poor if portions of the road are porous while other portions are impervious. Minor irregularities will disappear in the mixing process, but large areas of irregular grading require skillful treatment.

(*h*) Asphaltic materials must be applied uniformly under pressure. Streaks and omissions will be a constant source of future trouble.

(*i*) California asphaltic residual oil does not evaporate under atmospheric conditions, and hardens by oxidation but slowly. Therefore, excessive applications should be avoided during construction and maintenance. This precaution is now better observed during construction than formerly, but is still neglected in maintenance. Excess oil in patching causes lumps which are hard to remove. Reoiling should be done sparingly and only where there is clearly a deficiency in oil.

(*j*) Cover material for surface treatment should be coarse rather than fine. Clean chips are the best cover material. Fine material tends to form an unstable mat and absorbs oil which should be allowed to penetrate. Success with the surface-mixing method requires sufficient insert fines to fill all voids. If not already present they may be added. Fuel oil will not bind clean, coarse material.

(*k*) Heavy clay binder mingled with the road metal greatly reduces the probability of success with oil treatment. A road that breaks up in the spring or that becomes muddy in wet weather should not be oiled.

State Highway Funds for City Streets

By a provision of Chapter 255, Laws of 1927 of the state of Kansas, "The boards of county commissioners of the various counties shall annually apportion and distribute to each city within their respective counties from the county and state roads fund, two hundred fifty dollars ($250) for each mile or fraction of a mile of streets within the city limits, heretofore or hereafter selected by the state highway commission as a part of, or a connecting link in, the state highway system. In lieu of such apportionment, the county may maintain the roads of the state highway system through any third-class city in such county located on the state highway

system and shall pay the cost of such maintenance from the county and state road fund."

To provide for the carrying out of this law, the State Highway Commission has prepared an agreement to be entered into between the boards of county commissioners and the governing bodies of the cities in the respective counties as to the amount the cities shall receive from the county and state roads fund, when it shall be paid, and on what streets it shall be expended.

The gist of this agreement is that the city will maintain the streets that have been selected as a part of or a connecting link in the state highway system. That in consideration of this work by the city, the county will pay to the city $250 per mile per year for each mile or fraction thereof of the streets constituting a part of the state highway system, the total sum to be payable in four installments on January 1, April 1, July 1 and October 1. That the city will keep the money in a separate fund and that all vouchers and expenditures from this fund will be subject to the inspection and examination of the state highway commission so that all work will be subject to the supervision of the state highway commission in accordance with the provisions of Chapter 255, Laws of 1927.

The attorney-general has ruled that under this law a city with 1¼ miles of state highway within its limits is entitled to receive as much as one with 2 miles. There are other questions that have arisen, and Albert B. Martin, counsel to the League of Kansas Municipalities, has given his opinion that the law requires the funds to be spent upon the streets designated as state highways; that if such streets do not now need repairs costing this amount, the sum should be placed in a fund to be drawn upon when needed; that if one street should comprise a part of two state highways it would entitle the city to only $250 a mile, not $500; that if a county elects to maintain the street it must do so in a manner approved by the state highway commission, be the cost less or more than $250 a mile; and that if a city does not need the whole $250 per year per mile it can not apply the balance to redeeming the bonded indebtedness created to pay for this paving or to any other purpose.

Relation of Toilet Type to Typhoid Prevalence

Statistics from Jefferson County, Alabama, showing numbers of typhoid cases where pit toilets, septic tanks, sewer connections, box and can toilets and open toilets prevail.

By K. W. Grimley*

There are approximately 31,000 homes in Jefferson County, Alabama, outside of the limits of Birmingham, which is the county seat and principal city. At the end of 1926, following five years of intensive sanitation throughout the county, approximately 83% of the homes were equipped with sanitary toilets, as compared to about 34% in 1921. The types of toilets used in this work included pits, septic tanks, box and can, and septic toilets, though comparatively few of the last two types were installed, the main effort being concentrated on pits and septic tanks, and on sewer extensions.

In 1921 there were 197 cases of typhoid reported; in 1926, there were 92. The case rate was reduced from 144.4 in 1921 to 57 in 1926. These figures related only to that portion of the county outside of Birmingham (which city for the past few years has enjoyed a remarkably low typhoid rate), but include Bessemer and Fairfield, cities of about 25,000 and 7,000 respectively.

The accompanying chart, Fig. 1, shows the reduction effected in typhoid cases, and also the number of sanitary toilets installed during the period. Fig. 2 shows the relation between the number of sanitary toilets in use and the typhoid case rate.

In this discussion, case rates are used rather than death rates because it was the fixed practice to hospitalize all typhoid cases possible. Consequently, most of the deaths resulting from these cases occurred in the city of Birmingham. There was excellent reporting and it was found easier, and as accurate, to base records for office use on case rates. The official typhoid death rate for Jefferson County is lower than that indicated by these figures because many of the deaths are charged to Birmingham, having occurred in hospitals in that city.

*Assistant Engr., Dept of Health, Jefferson Co., Ala.

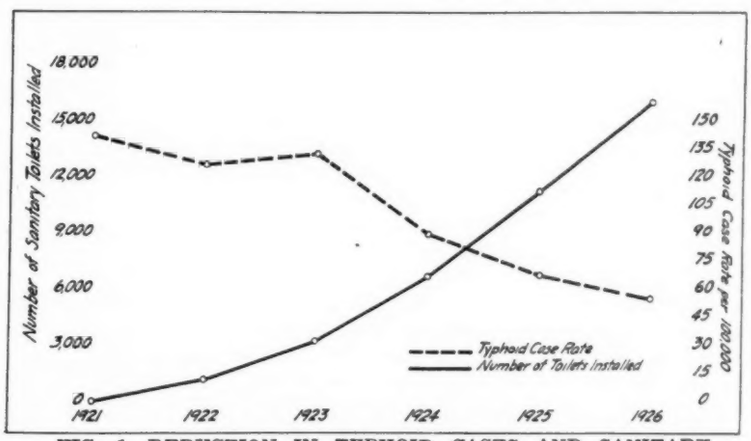


FIG. 1—REDUCTION IN TYPHOID CASES AND SANITARY TOILETS INSTALLED

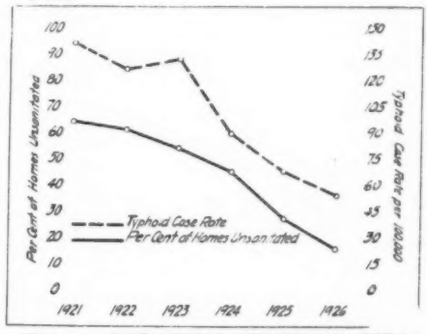


FIG. 2—RELATION BETWEEN NUMBER OF SANITARY TOILETS IN USE AND TYPHOID CASE RATE

The sanitary status of the 31,000 homes in Jefferson County was, at the close of 1926, approximately as follows:

With pit toilets	10.500	or	34%
With septic tanks or sewer connections	8,000	or	25.8
With box and can toilets	7,500	or	24.1
With open or surface toilets	5,000	or	16.1

Of the 92 cases of typhoid reported in 1926, approximately 41% occurred in homes served by box and can toilets; 24% in homes served by pit toilets; 8% in homes served by sewers or septic tanks; and 27% in homes having open or surface toilets.

Based on an arbitrary ratio of 1 for surface toilets, the efficiency of the various types of toilets in the prevention of typhoid fever appears, from the above figures, to be as follows:

Septic tanks and sewer connections	5.40
Pits	2.37
Box and can	1.00
Surface and open toilets	1.00

However, in all cases of this kind, other factors enter into the problem, making it more or less indeterminate. For instance, homes served by sewers and septic tanks are almost universally supplied with water from either the Birmingham or Bessemer supplies, both of which are of good quality. The rate, therefore, would normally be lower than in homes having well or spring supplies.

Also, the homes having open or surface toilets are found almost entirely in rural districts, where the chances for typhoid spread are much less than in the more congested sections, which are served by pit and by box and can installations. However, the communities served by these two types are fairly comparative, and probably represent quite truly the relative health protective values of these toilets. Most of the 7,500 box and can toilets are maintained and scavenged in a more sanitary manner than is usually found in municipal installations of this sort.

The types of toilets installed in Jefferson County are similar to those described in an article in the September, 1925, issue of Public Works.

Airplanes for Mosquito Control

Under this title we published in our April issue information concerning work done by the U. S. Public Health Service, aided by an airplane from the U. S. Marine Corps, in suppressing Anopheles mosquitoes in a swampy section of Virginia, using Paris green applied from an airplane. In the Sept. 23rd issue of "Public Health Reports" is given information concerning similar work done near Bamberg, South Carolina, in September of this year.

A mixture of Paris green and soapstone, 500 pounds of each, was distributed by 'plane onto a heavily overgrown pond, in which dense vegetation, both bushes and trees, shaded most of the surface and the flotage was heavy. The Ford monoplane which distributed it flew about 50 feet above the tops of the trees, gridironing the area with flights about an eighth of a mile apart both up and down and also across.

Before sprinkling, Anopheles larvae were found at the rate of five per dip, some being found in eleven out of every thirteen of the several hundred dippings. Thirty minutes after the sprinkling ceased and two hours after it began, no live larvae were found in the small clear area, but many dead ones; and where trees and bushes covered the water all full-grown larvae were dead but some first-stage larvae were still alive. However, twenty-two hours later, in 703 dips made in all types of flotage where it and vegetation were densest, only three living larvae were found, 84 dead larvae and six living pupae.

Design of Mixing Channel Having Small Loss of Head

Experiments to determine type of baffled channel giving most thorough mixing with least loss of head

By Glen N. Cox*

This article describes experiments conducted to secure, by means of a baffled channel, effective mixing of a chemical or sludge with flowing water or sewage, while keeping the head loss in the channel as small as feasible. Also, as the amount of head available for such a channel is often limted to a few inches, it was assumed that such tests as these would give a rough idea of how to design such a channel when the volume of flow and the head available were given.

These experiments were performed at this time because the new sewage disposal plants under construction at Waupun and Oconomowoc, Wisconsin, were to be provided with such mixing channels. At Waupun, where the presence of industrial waste in the sewage makes chemical treatment advisable, the settled chemical sludge was to be returned to the inlet of the plant and mixed with the incoming raw, untreated sewage. At Oconomowoc the effluent from a Dorr clarifier was to be treated with lime or alum during the pea canning season. To mix the sludge or chemical with the sewage effectively, with a minimum loss of head, was the problem to be solved.

The experiments were conducted for W. G. Kirchoffer, hydraulic and sanitary engineer of Madison, Wisconsin, at the hydraulic laboratory of the University of Wisconsin by the writer under the direction of Prof. C. I. Corp.

The experimental channel was 2 ft. wide and had baffles for a distance of 21 ft. (see Fig. 1-a). A weir 1.14 ft. high extended across the channel 3 ft. upstream from the first baffle. The effect of the weir would be to somewhat concentrate the velocity near the water surface and thus slightly increase the total loss of head through the channel. Three feet downstream from the last baffle a hinge gate was located by means of which the water level in

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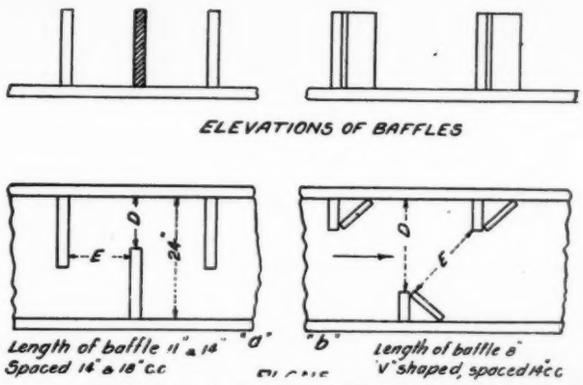

FIG 1—GENERAL PLAN OF APPARATUS, SHOWING TYPES OF BAFFLES USED

the channel was regulated. Actual plant conditions were thus assimilated, since in a plant the outlet depth would be kept constant by means of a weir over which the sewage would flow. This baffled channel differed from those commonly used in water treatment plants in that the direction of flow is reversed more frequently and quickly.

Three series of experiments were run: First, baffles 2 in. wide and 14 in. long, spaced on both 14 in. and 18 in. centers; second, baffles 2 in. wide and 11 in. long, spaced on both 14 in. and 18 in. centers; and third, special baffles 8 in. wide next the side wall, 2 in. wide at the outer end, and extending into the stream a distance of 6 in., spaced on 14 in. centers (see Fig. 1-b).

Fortunately the experimental channel was of the same length and size proposed in preliminary design for the Waupun plant, so that losses of head for given discharges could be measured directly. The loss of head through the channel when provided with the general type baffle shown in Fig. 1-a was found to be greater than was permissable for the plant in question. When the type baffle of Fig. 1-b was used the loss of head was small. To provide for designing other channels where the conditions might be different, I have attempted an analysis of the causes for the flow conditions and have arrived at a method of computing this loss of head so that a channel to meet any conditions could be designed.

It was thought that the discharge would be a function of the cross section of the open stream, the wetted area of the upstream side of the baffles, the hydraulic radius, and the loss of head. At first it was thought that one of the forms of open channel flow formulas, such as Bazin's or Kutter's, could be used, but it was found that the friction factor as computed by these formulas was not as consistent as those found by method described below.

The summary data of the results of the tests are shown in the table.

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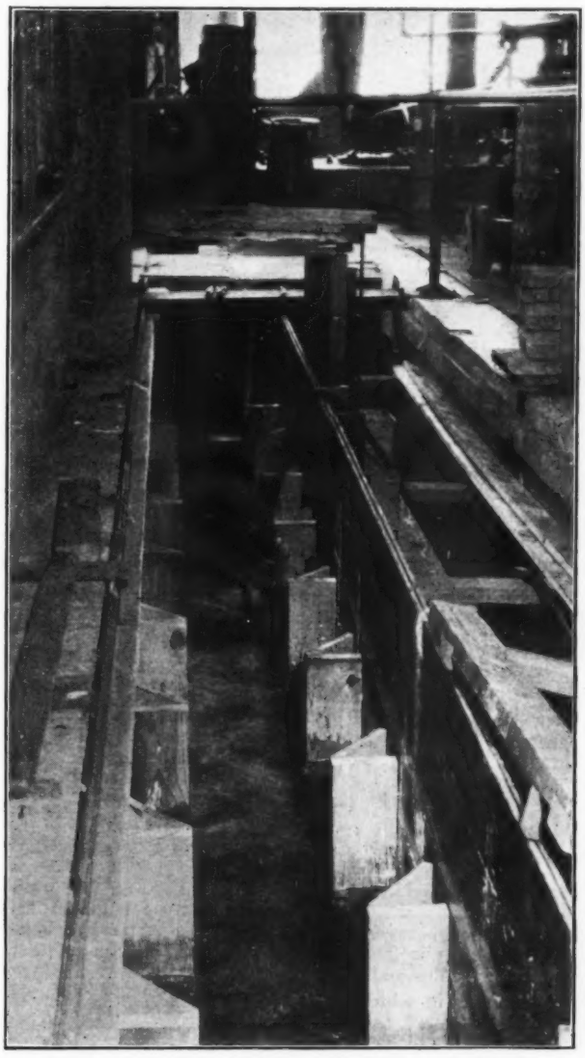


FIG. 2—MIXING CHANNEL WITH V-SHAPED BAFFLES

Summary Data on Flow Through a Baffled Mixing Channel.

Run No.	Length of Baffles Inches	Spacing of Baffles Inches	Discharge, Gallons per Minute	Velocity, Feet per Second	Downstream Depth, Feet	Loss of Head, Feet	C Chezy Coefficient	C Calculated as k-n B	Per Cent. Error from Chezy's Coefficient
1	14	14	400	0.81	1.00	0.64	8.25	8.40	1.8
2	14	14	500	0.93	0.99	0.84	8.17	8.15	0.2
3	14	14	600	1.01	1.00	1.01	8.04	7.90	—1.7
4	14	18	500	0.94	1.00	0.74	8.78	8.81	0.3
5	11	14	500	0.73	1.00	0.73	7.18	7.30	1.7
6	11	14	500	0.90	0.33	1.27	8.09	9.76	20.6
7	11	14	500	0.62	1.45	0.42	7.52	5.27	—29.9
8	11	18	500	0.79	1.01	0.58	7.72	9.35	21.1
9	11	18	500	0.57	1.20	0.44	7.99	8.73	9.3
10	11	18	500	0.67	1.35	0.37	7.95	8.15	2.5
11	11	18	500	0.63	1.49	0.31	8.09	7.60	—6.1
12	11	18	500	0.58	1.62	0.27	8.03	7.08	—11.7
13	11 V-shaped	18	500	0.72	1.63	0.30	7.50	6.88	—8.3
14	6	14	250	0.54	0.70	0.03	23.67	18.4	—22.3
15	6	14	500	0.96	0.70	0.17	17.38	17.5	0.6
16	6	14	750	1.28	0.70	0.32	16.30	16.5	1.2
17	6	14	1,000	1.51	0.70	0.52	14.77	14.9	0.7

known formulas, it was found that Chezy's formula for flow of water in open channels, $v=c\sqrt{rs}$, best fit these conditions, and that $c=k-nB$. Both k and n are emperical constants determined experimentally from these tests. B is the sum of the mean wetted depths of all of the baffles. This method of analysis of the loss of head in baffled channels is based on a comparatively few observations and more experimentation may prove it to be a faulty one. The values of k and n in the formulas for c were found for each length of baffle as follows:

Length of Baffle	Coef.		k		n
14"	c	=	11.1	—	.106 B
11"	c	=	16.0	—	.341 B
6" V shaped	c	=	27.2	—	0.680 B

The area used for obtaining the mean velocity was the smallest area between the end of the baffles and the nearest wall, whether this be a baffle wall or the side of the channel. The position for measuring this area is shown in Fig. 1, a and b; dimensions D being used whenever it is less than E. All measurements for areas and hydraulic radius were taken where the water was mean depth between the ends of the channel.

Although there is considerable variation in the values of k and n for each set of baffles, there is a rather close relationship between the valus of c in the Chazy formula when it is computed from the values of Q, r and s and when computed from the values derived from the expression k—nB.

The following illustrates the use of the curves of Fig. 3 in the design of a mixing chanel:

Problem: Find the discharge through a 2 ft. 6 in. mixing channel having 20 baffles 0.3 the width of the channel, spaced 1.333 ft. centers. Permissable loss of head is 0.25 ft. and let the depth at the outlet be taken as 0.75.

Solution:

From the curve k=23.5, n=0.593

$$B=20\left[.75+\frac{.25}{2}\right]=17.5$$

from which C=13.12

In this case, the smallest passage way for the water is the distance between the points of two successive baffles. This distance is 20 in. and will be used in computing the hydraulic radius and mean velocity.

$V=C\sqrt{rs}$ in which

$$r=\frac{1.458}{3.417}$$

$$s=\frac{0.25}{26.67}$$

$$V=13.12\sqrt{\frac{1.458}{3.417}\times\frac{0.25}{26.67}}=0.830$$

$Q=AV=1.458\times0.830=1.21$ c.f.s.$=543$ g.p.m.

Observations made during these experiments when hydrated lime was used showed conclusively that stream line flow does comparatively little to effect a mixing of a chemical with a fluid. At points where this type of flow existed, the lime settled to the bottom of the channel and remained there. Violent turbulent flow is unnecessary, but water flowing with slight cross currents, as shown clearly in the photograph of Fig. 2, will produce a satisfactory mixing.

Lime deposited through a pipe on the downstream side of the straight baffles (Fig. 1-a) was not picked up by the current, whereas that deposited in the same manner about the V-shaped baffles (Fig. 1-b) was always picked up. This V-shaped type of baffle seemed to produce the most uniform mixing with the least head and the fewest "dead" spots.

This design of a mixing channel could be applied to a mixing tank for water treatment in which vertical or horizontal flow was used. Each individual passageway in the tank would be treated as a channel in this design and the areas of baffles and losses of head would be computed in the same manner.

Summing up, there are several decided advantages in favor of the mixing channel having the type baffle that was adopted:

1. Thorough mixing.
2. Small loss of head.
3. No dead spots in which sludge might collect and putrefy.
4. Simplicity of design.
5. Sturdiness of baffles.

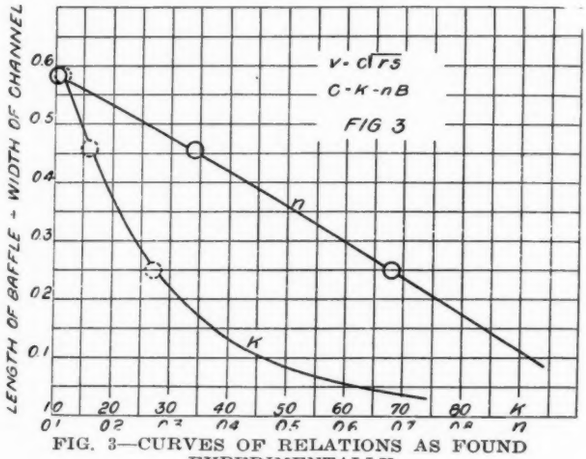


FIG. 3—CURVES OF RELATIONS AS FOUND EXPERIMENTALLY

It is considered that there should be between 15 and 20 baffles in the channel. These baffles should be between 25 and 30 per cent of the width of the channel. The shorter baffle would be used in narrow channels where the velocities are low and where the quantity of water to be deflected is not great. In the design of channels three feet or more wide, the length of baffle should be somewhat increased. These baffles should be spaced on centers of 50 to 75 per cent of the width of the channel.

Up to date, there have been so few data upon which to base a rational design for a mixing channel that this information is given for its possible help to others and to stimulate further experimentation.

Service for City Managers

For providing city managers with technical guidance in their administration of the various municipal activities, a technical service agency is to be established at Northwestern University, Evanston, Illinois.

The agency will be directed by Dr. A. R. Hatton, author of the Cleveland City Manager charter and former Cleveland councilman, who has been selected

to fill the chair of political science at Northwestern. A fund of $500,000 will be available for the new service.

The new organization will work in close cooperation with the International City Managers' Association, which will move its headquarters from Lawrence, Kansas to Evanston.

The fundamental purpose of the new service will be to promote greater efficiency in city-manager governments rather than to campaign for its adoption in cities that are not yet blessed with this type of government.

Dr. Hatton states that: "Research and investigation will be carried on by the public management service with experts in their line on the staff to aid any work desired by the managers. We plan to grade or rate city governments into various classes after investigations and then work to bring them up to the highest possible efficiency."

Street Runoff Records

Committee comprising engineers of the five boroughs of Greater New York obtaining, compiling and analyzing data on which to base calculation of storm sewer sizes.

The Board of Estimate and Apportionment of New York City in 1922 appointed a committee "for the express purpose of obtaining adequate data upon which to base drainage plans," which committee, consisting of six engineers of the several boroughs aided by a sub-committee of six engineers, has since been collecting such data.

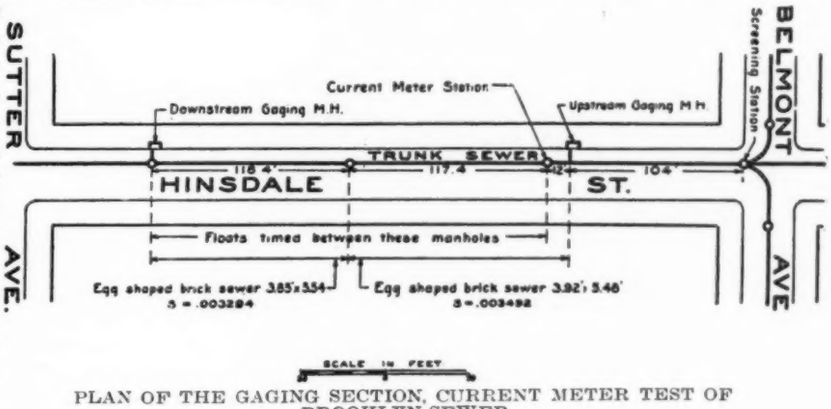
An experimental area was selected in a partly developed portion of the East New York section of Brooklyn, containing about 200 acres, of which about 18% is pervious surface, 20% is semi-pervious surface, 52% is impervious surface and 10% is undrained surface. Records have been made of the rainfall and sewer runoff in this area. Another experimental area has been selected in Manhattan to be studied in the same way. The work is proceeding slowly, as it is necessary to obtain records of a large number of storms of various intensities and durations to permit calculation of conclusions which will be of general applicability and reasonably reliable. The chief engineer of the Board, Arthur S. Tuttle, informs us that it is not at all likely that the committee will attempt to formulate a report until its investigations have been completed or have at least proceeded far enough to justify definite preliminary recommendations, which is probably several years off. It is expected that after the work has been fully completed and the results placed in the hands of each member of the committee, Kenneth Allen, sanitary engineer of the board, and assistant engineer Seaver will prepare a review of the work and the conclusions from the figures obtained. Such report should be of great interest not only to the sewerage engineers of the various boroughs of Greater New York but to all sewerage engineers throughout the country.

Meantime, brief reports are being given in the annual reports of the Board of Estimate and Apportionment. The report for 1925 states that during the season between May 1 and November 13, 1925, three tipping-bucket rain gages and two sewer gages were used, the latter installed in gaging manholes and recording the elevation of the hydraulic gradient at two points in the trunk sewer draining the selected area.

From the year's records, 24 storms were selected for analysis. Comparisons were made between accumulated rainfall and runoff, and between rates of rainfall and runoff throughout each storm, and the coefficients of runoff were computed. Incidental to this work, a method based on the general principles of the rational formula was developed for analyzing storms of varying rainfall intensity and storms of shorter duration than the drainage area concentration period. Runoff coefficients and data for the 24 storms analyzed are shown in the accompanying table.

Date of Storm, 1925		Duration of Storm, hr., min.	Total Rainfall, Inches	Total Run-off, Inches	Peak Flow in Sewer, Inches per Hour	Ratio Total Run-off to Total Rainfall	Observed Run-off Coefficient at Peak Flow in Sewer
May	10....	1–44	.385	.197	.42	.51	.45
"	11....	4–03	.585	.348	.25	.60	.62
"	24....	6–50	.840	.457	.18	.54	.57
"	29....	6–26	.580	.262	.20	.45	.56
June	9....	0–32	.285	.068	.11	.24	.16
"	14....	0–16	.215	.080	.18	.37	.33
"	16....	2–07	.700	.344	.55	.49	.37
"	20....	0–03	.110	.045	.125	.41	.35
"	25....	0–25	.527	.264	.55	.50	.36
"	28....	0–13	.105	.021	.055	.20	.21
"	29....	4–21	1.620	.724	.64	.45	.29
July	7....	0–18	.045	.024	.07	.53	.63
"	10....	1–30	1.113	.514	.53	.46	.41
"	16....	2–19	.493	.248	.355	.50	.45
"	22....	2–02	.243	.081	.125	.33	.30
"	26....	1–46	.273	.130	.105	.48	.45
"	28....	1–17	.463	.228	.48	.49	.42
"	31....	9–04	2.420	1.100	.58	.45	.38
Aug.	14....	0–35	.267	.121	.325	.45	.41
Oct.	5....	1–15	.273	.107	.15	.39	.38
"	14....	6–03	1.043	.451	.24	.43	.46
"	16....	3–40	.767	.329	.245	.43	.48
"	25....	6–53	1.440	.616	.44	.43	.41
Nov.	8....	3–57	.263	.086	.075	.33	.28

To assist in fixing the value of the coefficient of roughness (n), as used in Kutter's formula for



PLAN OF THE GAGING SECTION, CURRENT METER TEST OF BROOKLYN SEWER

determining velocity, for the gaging section of this sewer when carrying storm flow, a current meter test of the dry weather flow was made on August 4 with the cooperation of the Brooklyn Bureau of Sewers. The method adopted was to measure the velocity by current meter at one of the manholes, screening out as much of the suspended matter as possible at the next manhole above. The elevation of the hydraulic grade line was measured at the two gaging manholes by simultaneous readings of the indicators on the water stage recorders at one minute intervals throughout the test. Floats, timed through the gaging section, served as a check on the surface velocities, as determined by current meter. The current meter used for this work was a Price electric meter with ear-phones, equipped with a long wooden handle to permit operation from the street level. Notched sticks, wedged across the sewer and across the top of the manhole, and stops on the handle, enabled the current meter wheel to be placed at any predetermined point in the sewer cross-section. Nine points were selected in the cross-section and five current meter readings taken at each point.

WATER STAGE RECORDER, WITH DOORS REMOVED

Similar doors on opposite side also removable. Elevation of water surface in sewer recorded at two points 247 feet apart, each of which has a recorder of this type.

SHEET IRON SHELTER FOR WATER STAGE RECORDER AT SEWER GAGING STATION.
The frame is bolted down to the sidewalk.

To prevent suspended matter in the sewage from clogging the meter wheel, a dozen screens made of 1 inch chicken wire nailed to light wooden frames were employed, these being held in place by a stick wedged vertically in the sewer. The screens were changed once a minute, the twelve screens giving about ten minutes of clear water for the current meter work. Clogged screens were then cleaned with a fire-hose.

An examination of the gage depths plotted on a diagram showed the gaging section is part of a surging backwater, the downstream averaging about 0.3 foot more than the upstream depth. To obtain a correct value for the coefficient "n" and eliminate errors due to surging, it was necessary to take the average of a large number of determinations. A discharge diagram based on the point velocities was accordingly made for the current meter station and, for the gaging section, backwater charts were drawn for values of "n" of .014, .015 and .016, giving the theoretical discharge for any combination of gage readings. A comparison between the dicharges read from the backwater charts and from the discharge diagram of the current meter station, gives by interpolation the value of "n" for each pair of gage readings.

The average value of "n" for that portion of the wetted perimeter covered by the dry weather flow was determined from the test as .016. As an inspection of the sewer showed the side walls and arch to be somewhat smoother and cleaner than the invert, the value of "n" for the gaging section of the sewer when carrying storm flow was fixed at .015.

The rain gages are the standard Friez tipping bucket gages but the recorders are of special design developed and constructed by Julien P. Friez & Sons to meet the needs of the experiments. A very open scale was desired in order to permit a much closer analysis to be made of the record than was possible on the stock type of recorder. The water stage recorders for use in measuring the flow in the sewer were also specially designed for this work with an unusually open scale. They are the Au type of water stage recorder (Friez & Sons) modified to suit the requirements of the experiments.

The committee consists of the chief engineer of the Board, Arthur S. Tuttle, as chairman; Clifford

M. Pinckney, chief engineer of the Borough of Manhattan; Philip E. Farley, consulting engineer of the Borough of Brooklyn; Josiah H. Fitch, chief engineer of the Borough of the Bronx; Clifford C. B. Moore consulting engineer of the Borough of Queens; and Theodor S. Oxholm, consulting engineer of the Borough of Richmond. These are being assisted in the investigation by a sub-committee consisting of John C. Riedel, ass't. engineer, Borough of Brooklyn; Harry W. Levy, principal ass't. engineer, Borough of Manhattan; Edward W. Wood, assistant engineer, Borough of the Bronx; Frederick Seely, ass't engineer, Borough of Queens; Victor H. Riechelt, ass't. engineer, Borough of Richmond; and Kenneth Allen, sanitary engineer of the Board of Estimate and Apportionment; with Arthur W. Tidd, ass't engineer of the Board of Estimate and Apportionment, as secretary.

Operating Sewage Treatment Plants

Reasons for unsatisfactory results. Suggested operating details for septic and Imhoff tanks, sprinkling filters, contact filters and sand beds.

Of ninety sewage treatment plants in Kansas, only 36 are said by J. L. Barron, of the State Water and Sewerage Laboratories, to receive adequate attention. "This does not mean that satisfactory treatment is being secured in this number, because many of these plants are either out of date or lacking in essential units or capacity; but the cities are looking after them and trying to get results."

Of the other 54 plants, 33 receive some attention at varying intervals but not sufficient to keep them in constant operating condition; while 21 either are not operated at all or have been so neglected that they have ceased to function.

One of the chief reasons for failure in operation is believed by Mr. Barron to be the practice of making the care of the disposal plant just one more job for a city official who is already over-burdened (or gives this as an excuse). A plant which operates with only a few minutes attention once or twice a week is likely to be visited only once a month. But if details of operation which can be performed in a few moments are neglected altogether, the resulting conditions may take days of labor to overcome.

"Another important reason for difficulties with operation is the failure of the man in charge to understand the principles of the treatment." Moreover, since nuisance resulting from failure to operate properly does not inconvenience the community that owns the plant, the plant operator frequently does not feel the urge of responsibility in the matter.

Mr. Barron gives some suggestions for operating the types of plant common in Kansas—septic tanks, Imhoff tanks, sand filters, sprinkling filters, and contact beds. Concerning the last he says: "The rock contact bed, although a distinct advance in sewage treatment at the time, has never proved particularly efficient. This is due partly to its having been in combination with rather unsatisfactory primary treatment and partly to its use for low head installations with air-lock feed apparatus which has always been a source of annoyance." Two contact bed plants in Kansas are to be replaced with other types.

"Sand filters perhaps give the highest efficiency of any form of secondary treatment;" and a well-constructed bed, evenly dosed with clarified sewage, should produce a satisfactory effluent with little difficulty for the operator.

It is desirable to prevent the introduction of any grease or oil waste into sewage plants. Garages and filling stations constitute the chief offenders and they frequently surreptitiously dump crank case oil and other waste into the sewer, even after having been warned against the practice. It is desirable to have a municipal ordinance prohibiting waste drain connections from such establishments except through properly constructed grease traps. The supervision of these traps should be definitely delegated to one man, possibly having police authority, who should make regular inspections and require immediate cleaning where necessary.

Under ordinary circumstances flush tanks should discharge once in 24 hours and not less frequently. Too frequent discharge not only wastes water but may overload the disposal plant.

A septic tank should be cleaned before sludge and scum have accumulated to the point where solids are being carried out in the effluent. Every septic tank should have as part of its equipment a sludge pump or removal apparatus. An up-to-date pump of this kind always proves to be a good investment from the standpoint of actual cleaning cost and also because the tank is cleaned more frequently. Where there are enough tanks to make it practicable, it is good practice to allow a tank to stand for several weeks before cleaning, to permit the digestion of the sludge to be carried somewhat further and reduce the odors that might arise from green sludge on a drying bed.

In the case of Imhoff tanks, the author quotes Harrison P. Eddy as saying: "The drawing of sludge in the spring should be postponed as long as practicable in order to reduce the danger of removing offensive, ill smelling sludge. On the other hand, it must not be allowed to accumulate to the extent of causing foaming or other difficulties."

While the cause of foaming is not well understood, it is known that it is likely to occur when the sludge compartment is full and solids are accumulating in the slots. In this case it can always be stopped by a withdrawal of a portion of the sludge. In other cases, however, foaming has appeared to follow more or less directly the complete removal of the solids or to be aggravated by this procedure, and it is therefore of extreme importance that the removal of sludge be stopped while the flow is still thick and heavy. It is also important to avoid a too rapid flow of sludge, for the ripened deposit at the bottom may not flow into the center fast enough and this may allow green sludge or the liquid above to pass out into the sludge pipe. Sludge should be drawn as late in the fall as drying conditions will

permit. During the summer months, smaller amounts should be removed at shorter intervals.

Gas vents require frequent attention of the operator. Scum should not be allowed to become more than a few inches deep nor should it be permitted to form a hard, dry mass which will prevent the free escape of gas. Stirring or thorough agitating of the scum at frequent intervals will ordinarily keep it in the desired condition by causing a part of the solids to settle. Also, if the scum is thoroughly wet, the partial digestion of the solids is continued. Many of the newer installations are provided with drain pipes in the vents for the removal of the wet scum to the sludge drying beds. Occasionally there is an accumulation of waste either in the vents or in the flowing-through chamber, which can be disposed of only by skimming.

The primary purpose of sand filters is not to filter but to accomplish oxidation. If the surface becomes sealed and the filter ponded, the oxidizing bacteria are partially destroyed and the organic growth on the sand grains becomes inert clogging material. Under normal operation, the solids which are deposited on the surface should be removed as often as necessary with as little loss of sand as possible. The sand must be kept level and the distributing troughs in order so that all parts of the bed will be uniformly dosed. At no time of the year do sand filters serve the best interests for the community when propagating tomato and watermellon vines, sand burrs or Russian thistles.

Trickling filters are more nearly fool-proof than other types of secondary treatment, but the spray nozzles require rather frequent inspection for the removal of clogging materials. Experience has shown that a very hard, impervious rock, at least at the surface, is necessary to stand the rigors of a succession of Kansas winters. Provision should be made for cleaning final settling tanks by means of either pumps or hydrostatic pressure. If septic conditions develop in these tanks, the sewage may be partially robbed of its dissolved oxygen and the effluent carry off suspended matter.

Most plants are equipped with some form of flood water protection in the nature of flap valves, either automatic or manually controlled, and such valves are very essential. The flap valves must be well oiled and working freely at all times; the section of outfall outside the protecting dike must be comparatively tight and any manholes on it either sealed or built above flood level; and the dike must be maintained at its proper elevation.

Trickling Filter Distributors

Most of the trickling filters used for treating sewage in the United States distribute the sewage by means of stationary nozzles. In England, on the other hand, moving distributors are the common practice. However, a few of the moving distributors have been installed in the United States. One of these is at Pontiac, Michigan, where revolving sprinklers are used, there being eight of these each 110 feet diameter and operating under a 14-inch head. At Oberlin, Ohio, a disposal plant which went into operation in the fall of 1926 uses travelling distributors in the form of steel frames extending across the beds and running on rails laid lengthwise of the beds, propelled by reversing motors, a large pipe fitted with nozzles being supported under this frame. The effluent is siphoned over into these pipes and sprayed out of the nozzles, thus laying a thin sheet of water over the beds as the distributor travels back and forth. After passing through four feet of stone the effluent passes to a secondary sedimentation tank. Considerable trouble was experienced with these filters during the summer months of 1926. Several motors were burned out at a time when it was well nigh impossible to get immediate service for repairs; but later were put in such shape that no further trouble from that source was anticipated.

City Manager D. F. Herrick, in his report for 1926, stated that "it seems at present that the plant will require 24 hour supervision in the near future since the filters will not work automatically as they were intended, for the reason that as the flow goes down in the early morning the siphon is broken and consequently the flow into the distributors stops. If this flow happens to increase, there is no way to make the siphon operate again, with the result that the beds will overflow."

Worcester Sewage Treatment Plant

Complete data concerning plant given by Superintendent Holmstrom in condensed form. Removing grease from tanks and grit from grit chambers.

New sewage treatment works for Worcester, Mass., were put into operation June 25, 1926. They were described in the December, 1926, issue of PUBLIC WORKS, where also was given a description of some features of operation of them. In his report for the year 1926 Andrew B. Holmstrom, superintendent of the Sewer Department, says that "The results of operation have been good and show a steady improvement." He states that the method of removing dried sludge from the sludge beds, by means of a bucket loader, described in the article referred to, saves about $14,000 a year.

The department was then working on a mechanical method of removing grease from the surface of the Imhoff tanks which far surpasses the use of hand skimmers for this purpose. This consists of placing at one end of the tanks, against a scum board, a pan 11 ft. 3 in. long, 6 in. wide and 2 in. deep, having a sloping bottom with a pocket at one end in which is placed a 3-in. hose connected to a diaphragm pump. The pan is adjustable up and down so that its edge can be kept just below the level of the grease, which is thus drawn into the pan when the pump is operated. The grease and accompanying water are discharged by the pump through a 6-in. pipe line onto a sludge drying area. While this

can not be used with cold, thick grease in winter, it promises well for the remainder of the year.

As described in our previous article, trouble had been experienced in cleaning the grit chambers, flushing them not having proved a success. During 1926 it was found that flushing from time to time, and after each flushing cleaning out the 25 to 30 cubic yards of heavy grit remaining in the chamber by using a clam shell on a Byers crane, was a very efficient method and gave a very low cost as compared to other more complicated schemes. The material discharged from the grit chambers was removed from the old intermittent sand filter once during the year, being loaded by a Barber-Greene bucket loader into carts and hauled to a dump. Approximately 552 cubic yards was removed at a cost of $293.55. It was estimated that allowance for this cost should be made by adding 35 to 40 cents per cubic yard to the cost of cleaning by flushing.

Screenings were buried without producing any offensive conditions. Attendance at the screen was regularly scheduled from 12.30 P. M. to 4 P. M., and two cleanings at night, about 6.30 P. M. and 5 A. M.; while during storm flows one man remains in constant attendance. The cost of attendance at the screens was $1,916.83, averaging 11.9 cts. per cubic foot of screenings removed or 23.3 cts. per million gallons of sewage.

The pipes of the dosing apparatus became clogged at intervals with growths and sewage solids, which were removed periodically by blowing through them compressed air furnished by a Sullivan air compressor operated by a motor. The walls of the dosing tank were washed down once a week, using a 1½ inch hose stream.

With 2,964 nozzles in use, an average of 242 per day were cleaned, or 294 per working day. The end nozzle of each lateral distributor was removed about once a week and the siphons allowed to discharge once, to flush out the pipes. It was found that the sewage or tank effluent was destroying the threads of the openings in the pipes into which the nozzles were screwed and it was decided to enlarge the holes and put brass bushings in them to receive the nozzles.

The payroll charges for maintenance and operation of the sewage treatment plant totaled about $4.10 per million gallons of sewage received at the plant. Including all materials and supplies, teaming and department transfers of labor, the records show a total net expenditure of $59,749, or $7.27 per million gallons of sewage received at the plant.

Quite complete data concerning the plant are given by Mr. Holmstrom in condensed form, which is reproduced below:

DESIGN AND CONSTRUCTION

1. Type of Plant: grit chambers, screens, Imhoff tanks, dosing tanks, trickling filters, secondary settling tanks, sludge drying beds.
2. Construction period: 1919 to 1925.
3. Operation started: June 25, 1925.
4. Basis of design: 28 M. G. D., population 242,000 in 1934.
5. Approximate cost: $3,500,000.

DISCHARGE OF SEWAGE

6. Estimated population using sewer system: 183,000.
7. Number of buildings connected: not known.
8. Daily discharge for year: max. 63.5 M. G.: min. 12 M. G.: aver. 22.5 M. G.
9. Daily discharge for each user: max. 347.1 gals.: min. 65.6 gals.: aver. 122.9 gals.
10. Daily quantity of factory waste: not known.
11. Daily leakage into sewers: estimated maximum: 4,000,000 gals.
12. Daily leakage per mile of sewer: estimated maximum: 20,500 gals.
13. Are quantities given under 8 to 12 estimated or measured? 8 measured: 9 population estimated: 11 and 12, estimated.

PRELIMINARY TREATMENT

14. Number of grit chambers: 2; 2-inch bar screens: 2.
15. Grit removal: average: C. F. p. M. G. sewage: 4.05.
16. Disposal of grit removed: fill nearby low areas.
17. Frequency of cleaning: average: each chamber once a month.
18. Cost of cleaning per cubic yard removed: $0.48.
19. Screenings removed: average: C. F. p. M. G. sewage.
20. Disposal of screenings: buried in low area near-by.
21. Screen attendance daily: normal: 4 hours once: 1 hour, twice.
22. Cost per cubic foot of removal and disposal: $0.12.

IMHOFF TANKS

23. Number of tanks: 12; 60x90x31 feet deep.
24. Total capacity of sedimentation compartments: 2.43 million gallons.
25. Average daily quantity of sewage treated: 22.5 M. G.
26. Average period of detention of sewage: 2.6 hours.
27. Total capacity of sludge compartments: (net) 4.62 million gallons.
28. Cubic feet of sludge compartment capacity per capita (design): 2.54.
29. Disposition of effluent: treatment by trickling filters.
30. Disposition of sludge: drawn on to drying beds; in winter, to waste area.
31. Volume of sludge produced per million gallons sewage: about 2700 gallons.
32. Frequency of sludge removal: once or twice each month.
33. Quantity of grease removed: cubic feet: 17,500.
34. Gas vent area: per cent of tank area: 21.
35. Quantity of scum removed: cubic feet: none.
36. Cost of Imhoff tanks: $878,434.94.
37. Cost of maintenance: $13,512.53.
38. Cost of maintenance per million gallons sewage treated: $1.64.

DOSING TANKS

39. Number of tanks: 4 pairs, total 8.
40. Capacity of each tank: 36,931 gallons.
41. Size of siphon: 36-inch, alternating.
42. Operating head: maximum, 7 feet; minimum, 1 foot.
43. Discharge period: (all nozzles) 3 minutes.
44. Filling period: (28 M. G. D. rate) 6½ minutes.

TRICKLING FILTERS

45. Area of filters: 752.5x792.0 feet; 13.68 acres, 4 units.
46. Kind, depth and size of filter material: bastard granite, trap rock; 10 feet deep; 1 to 3 inches.
47. Type of nozzles: Worcester, 13/16-inch orifice, 2964 nozzles.
48. Distribution system: Concrete and cast-iron pipe laid on filter material.
49. Drainage system: Concrete floor, slabs on edge on ridges; main drains about 200 feet apart.
50. Average daily quantity of tank effluent treated: about 22.0 M. G.
51. Average daily quantity of tank effluent treated per acre: about 1.57 M. G.
52. Maximum daily quantity of tank effluent treated: about 40 M. G.
53. Disposition of effluent: secondary settling tanks.
54. Average daily number of nozzles cleaned per acre: 21.
55. Cost of trickling filters: $1,375,544.00.
56. Cost of maintenance: $13,141.04.
57. Cost of maintenance per million gallons filtered: $1.60.

SECONDARY SETTLING TANKS

58. Number and size of tanks: 4; 60x120x15 feet deep.
59. Average period of detention of filter effluent: 2.2 hours.

60. Average daily quantity of filter effluent treated: 22.0 M. G.
61. Disposition of effluent: Blackstone River.
62. Disposition of sludge: pumped to drying beds.
63. Volume of sludge produced per million gallons sewage: not known.
64. Frequency of sludge removal: 4 times during the year.
65. Cost of secondary settling tanks: $129,491.47.
66. Cost of maintenance: $4,970.41.
67. Cost of maintenance per million gallons treated: $.60.

SLUDGE DISPOSAL

68. Area and number of drying beds: 21.95 acres; 22 beds, old sewage sand filters.
69. Area of sludge beds per capita (1926); 4.93 square feet.
70. Method of cleaning: Barber-Greene loader, horse-drawn Watson dump wagons.
71. Disposal of sludge: Dump, adjacent to drying beds.
72. Cubic yards of dried sludge removed: 12,835.
73. Estimated cubic yards of sludge removed by farmers: 200.
74. Cost of sludge disposal (excluding machine charge): $5,815.69.
75. Cost per cubic yard of sludge removed: $0.45.

Discussion of Water Works Details

Use of two mains to a street. Laying services in advance. Inspecting gate valves. Copper and brass services.

At the convention of the American Waterworks Association there was an interesting discussion of a number of questions in the "Superintendents' question Box" which brought out the ideas of a number of superintendents concerning many details of practice.

DOUBLE MAINS

One of these was the desirability of using two mains in a street, on opposite sides of the roadway. E. F. Dugger stated that in Newport News the double main procedure had been adopted for practically all of the main business and residential sections. About two or three years ago, practically all of the streets of these sections were paved and the water company adopted the method of installing a small main on the side of the street opposite the existing main. They found that the saving amounted to quite an item. Quite general use is made of 2-inch pipe for the second mains and these are tied to the large mains at the end of each block of about 550 feet length. W. S. Cramer, of Lexington, Kentucky, stated that his company had found difficulty in using 4-inch pipe for the smaller line and were now using 2-inch cast-iron mains and obtaining good results. The difficulty had been in obtaining circulations through the 4-inch lines, with the result that the water became stagnant, and sediment collected. The streets on which two lines are used are 60 feet between curbs, paved for the entire width. If they are not so paved, the company does not bother with double service.

M. C. Kinder, of Youngstown, stated that they had not attempted to use double mains unless feeling certain that the street is going to build up quickly and they would get back their investment in the second main very quickly from the excess cost they would charge the consumer for the service, the consumers being charged a uniform price regardless of the actual length of any individual service.

LAYING SERVICE PIPE BEFORE PAVING

Concerning laying service pipe in advance of paving, Mr. Kinder considered this absolutely uneconomical, although it was done at Youngstown. Youngstown being a rapidly growing city, when a street has been paved, 100% built-up condition is reached within three or four years, and this seems to be the only thing to do. Mr. Cramer said that Lexington also had had that idea, but several instances occurred which have changed their mind. It seems to be impossible to foretell development or what size of connection will be necessary for it, while in residential sections it is almost impossible to locate taps correctly because one lot line changes the whole situation. The taps are almost always found to be in the wrong position and a new one is needed for almost every lot. They are a continual source of expense and do little to reduce the amount of cutting into pavements necessary. Stephen H. Taylor of New Bedford said that his department had found it was not worth while to put in pipe in advance of paving. Mr. King, of Cleveland, Ohio, said that he favored the practice, and W. A. Hutchins, of Freeport, Ill., found no difficulty in locating the services properly before the street had been developed. In residence property he believed that they wasted less than 1 per cent. of the services put in beforehand and would never think of leaving out services in advance of paving. However, aside from these two or three speakers, the others seem to think that the practice was undesirable.

INSPECTING GATE VALVES

Regarding inspecting gate valves, S. B. Morris, of Pasadena, said that city operates every valve in the system up and down once a year; one or two men being maintained on that work throughout the year, repacking valves which show any leakage in the packing box and making any other repairs necessary. Robert B. Morse said that in the Washington suburban sanitary district they inspected the valves regularly, operating them twice a year, fall and spring. In addition to operating them fully up and down, they also back them off the seat several times in order to work out any small material that may be in them. Mr. Morse uses valve boxes on valves 12 inches and under, but on 16 inches and up they used manholes. G. A. Corine said Superior, Wisconsin, builds vaults for all valves that are 12 inches in size or larger, and recently wherever there is a possibility of paving the street in the near future they are putting in vaults on all valves, no matter what size.

MATERIALS FOR SERVICES

Discussing the use of copper and brass service pipe, Mr. Morse stated that they were just starting to use copper pipe, as was also F. W. Lane in St. Petersburg, Florida. Mr. Morris said that in Pasadena they were using copper pipe for sewer flush connections where they go through the manhole, having had trouble with corrosion of pipe of other materials in this location. William Luscombe, of Gary, Indiana reported that he had been investigating the use of brass pipe. Two superintendents who had used it told him that they had had considerable trou-

ble with brass pipe breaking where it was threaded, while others who had used copper said they preferred it to brass or to lead. W. S. Patton, of Ashland, Kentucky, said that they had almost discontinued the use of wrought-iron pipe and are now using 1½ and 2-inch cast-iron pipe for all the smaller sizes of services. In installing these cast-iron pipes, a small wrought iron pipe is first pushed across with a pipe pusher, then a somewhat larger size is pushed across, and finally the cast-iron pipe is shoved through the hole. Ashland has never returned to the use of galvanized pipe. The cast-iron gives little trouble from electrolysis, whereas the wrought iron was eaten out in a short time, it having been no infrequent occurence to have to renew the same wrought-iron service line once a year. He believed that cast-iron pipe in 1¼ and 2-inch sizes, cement coated, would be an ideal material for small service lines. Mr. Morris reported that he also had for a number of years been using 1¼-inch McWane cast iron pipe and found it very satisfactory. Mr. Lane stated that they had put in about two miles of the 1¼-inch pipe in St. Petersburg.

DOMESTIC METER SIZES

Discussing the subject of proper sizes of meters for domestic supply, Mr. Morris and Mr. Morse have a graduated service charge based on the size of meter, and generally gave a consumer the size he wanted to pay for, although most used the ¾ inch; the former basing the increased charge not only on the greater interest, depreciation, maintenance and operation costs of the larger meter but also on the greater amount of unregistered water that it will pass. Mr. Morse charges from $4 a year for a ⅝ inch meter to $360 for an 8-inch.

Forestation of Water Catchment Areas

Benefits due to intercepting and storing rainfall. Less evaporation in woods, absorption by forest floor, and removal of suspended matter from surface run-off.

The water works departments of a number of cities in this country have for some years past been systematically planting trees upon the catchment areas from which their water supplies are derived, and figures have been presented from time to time to show the revenue which may ultimately be derived from this practice. More important than this revenue, however, is the benefit derived in connection with the intercepting and storing of the rainfall and runoff. In a paper read last summer before the British Water Works Association, Dr. A. W. Bothwick discussed these advantages at some length.

Referring to the argument sometimes advanced that foliage of trees intercepts falling rain and that there is a loss through the evaporation of this water directly from the leaves and by transpiration through the branches and leaves of moisture withdrawn from the soil, he presented figures to show that there was no reason to suppose that forests draw more water from the soil or prevent more water from entering the soil than do other forms of vegetation.

Where no forests exist, rain falls unhindered to the ground and in upland and mountain regions there is a tendency either for the soil to be beaten into a hardened surface or washed away to the bare rocks. In either case the rain, being unable to sink into the ground, runs off as soon as it falls and there is no ground storage; in addition to which the soil is washed down into the reservoir, tending to silt it up.

Since the air in forests has not as much motion as that outside due to the canopy of trees, and the relative humidity is higher, the amount of water evaporated into the air and lost is only about half of that from an equal area of adjacent soil in the open, if both soils have the same absorbent capacity; but generally the forest floor is of humus, which aids to prevent evaporation. If evaporation in the open be expressed by 100, the evaporation in the forest is reduced to 47 as a result of the canopy of foliage alone, and to 22 as the result of canopy plus humus. It has been found that from an open surface of water within the forest there is evaporated 64 per cent less water than from a similar surface outside the forest; this percentage remaining fairly constant at all seasons, and being apparently due to the less movement of air in the forest. Even assuming that one quarter of the rainfall is withheld from the forest cover by the foliage and re-evaporated, the loss from the three quarters that reaches the soil is only one-fifth or one-sixth of that which falls on unforested ground and the final result is that more water is retained by the forest-covered soil and allowed to percolate to the deeper layers.

The absorptive capacity of different kinds of moss and leaf litter may vary from 25 to over 50 gallons of water per cubic yard. The annual leaf fall in coniferous woods may vary from 12 to 20 cubic yards per acre, (in beech woods, 34 cubic yards). The forest floor therefore becomes a huge sponge. capable of holding by hygroscopic and capillary action a large amount of water. There is good authority for stating that forest litter, the moss-covered and leaf-strewn ground, is capable of absorbing water at the rate of from 40,000,000 to 50,000,000 cubic feet per square mile in 10 minutes —water whose progress is delayed some twelve to fifteen hours after the first effects of a heavy freshet have passed.

Thus the upper spongy humus layer and the underlying unhardened, porous mineral soil, penetrated and kept open by the deeper ramification of the tree roots, can hold a large quantity of water before it becomes thoroughly saturated, and when this point has been reached, the flow-off to the springs and water channels is gradual and prolonged. This uniformity of flow is continued throughout dry periods, thus mitigating the evil effects of all kinds of floods and droughts.

On the other hand, a covering of grass in hilly districts may be less favorable to water conservation than no covering at all. A turf covering may prevent the soil being washed away, but at the same time it prevents the rain from entering the soil. Much of the rain runs off the surface, the matted and interwoven root system of the turf preventing

the water from being absorbed. That which is caught by the grass and herbage is soon evaporated and the vegetation itself gives off large quantities of water by transpiration. It has been found that even after prolonged rains, the underlying soil remains quite dry.

The forest also has a regulating effect upon run-off from the higher slopes above the zone of trees. It acts as a kind of barrage between the summit of a ridge and the valley below. Surface flow from the higher slopes is absorbed and disappears when the forest zone is reached. Water which reaches the forest turbid and muddy, with peaty and earthy matter in suspension, after filtering through the forest becomes clear.

These considerations seem to justify the conclusion that forestation of catchment areas is the best means for securing increased storage capacity in the catchment area; regulation of supply by prevention of alternate floods and droughts; slower melting of the snow and retention of large reserves of water for the ensuing drier seasons; and purity of the water supply by elimination of mud and silt, with freedom from possible contamination by grazing or agricultural use of the catchment area.

Forests differ markedly in many respects, such as in regard to species of trees, composition (whether pure, mixed, single or double storied, etc.), age and treatment. Coniferous and evergreen forests have many advantages over broad-leaved or deciduous forests. It is important that normal density be maintained, so that the maximum benefit may be obtained from the canopy and the humus layer of the forest floor, which is very dependent upon the density of the woods. Care should be exercised to secure sufficient diversity in the number and distribution of age classes, so that cuttings may be confined to small, isolated areas. The maximum benefit would be obtained by the adoption of the selection system, as applied to absolute protection forests.

Holland Tunnel Opening

The official opening of the Holland Tunnel, connecting New York and New Jersey under the Hudson river, will take place on November 12th. Ground was broken for the first contract on October 12, 1920. The cost of the tunnel has been $48,400,000, half of which is paid by each of the two states. The tunnel is 9,250 feet long, the longest vehicular tunnel in the world. There are in reality two tunnels, each 29 feet 6 inches outside diameter and containing a roadway with a width of 20 feet, along the left side of which in each tube runs an elevated sidewalk 2 feet 10 inches wide, to be used only by the traffic police, who will control traffic in the tunnel day and night. The head room on the roadway is 13 feet 6 inches. The maximum down grade in the tunnel is 4.06 per cent and the maximum up grade is 3.8 per cent.

Before entering the tunnels, the vehicles will be separated into two lines of traffic, one made up principally of pleasure cars and the other of slow-moving vehicles such as trucks. The maximum speed has been fixed at 20 miles an hour, and the minimum speed of the fast line on up-grades at 16 miles, and of the slow line at 8 miles. The tunnel will have a daily capacity of 46,000 vehicles.

A telephone and signal light system, with stations at every police post, will enable guards to spread information instantly from one end of the tunnel to the other in case of an accident or traffic jam. Emergency fire fighting apparatus has been installed at the police posts and two combination fire patrol and wrecking cars will be kept waiting at the exits of the tubes.

The walls of the tunnel are lined with a vitreous white tile, which will be easy to clean and also adds to the brilliant lighting of the tunnel. Electric lights, set in openings near the top of the side wall on each side of the tunnel and covered with diffusing glass, will keep the tunnel brightly illuminated, but without any glare or shadows. Overhead are red and green signal lights with a special emergency signal, which, when illuminated, bears the words "Stop Engine," a notice to the drivers of vehicles that the motors should be shut down when the cars come to a standstill.

The ventilating system is unique. The system adopted involves a transverse instead of a longitudinal movement of air, the foul air being drawn up into a large duct at the top of the tunnel and the fresh air being introduced from a similar duct in the bottom of the tunnel through side openings near the floor extending the full length of the tunnel. The air in the tunnel will, it is estimated, be changed 42 times each hour, the total amount of fresh air to be supplied to the tunnel each minute being 3,761,000 cubic feet. It is estimated that this will keep the carbon monoxide down to 4 parts in 10,000 parts of air. Four large ventilation buildings, one at each edge of the river and the other two near the ends of the approaches, contain 84 blower and exhaust fans, the driving of which will require 4,000 h. p. Electric current for this operation will be obtained from both sides of the river, with two independent generating sources on each side and three independent cables leading from each source. It is believed that this will sufficiently assure against any breakdown in the ventilation system

Chlorinating Sewage

Chlorinating sewage or sewage effluent is now practiced in more than 400 plants in the United States. Two of the largest are those of Cleveland, Ohio. In 1926, according to George B. Gascoigne, consulting sanitary engineer of that city, the Easterly Treatment Works used an average of 68.4 pounds of chlorine per million gallons and the Westerly Treatment Works an average of 74.1 pounds. At the Easterly Works the total bacteria at 37 deg. C., in thousands per c.c., was 3,470 in the coarse-screened sewage and 127 in the disinfected effluent, a removal of 96 per cent; while the B-coli totalled 161 in the sewage and 8.87 in the disinfected effluent, a removal of 94.5 per cent. In the Westerly Treatment Works the total bacteria averaged 1,062 in the crude sewage, 1,147 in the Imhoff tank effluent and 235 in the disinfected effluent, a removal of 78 per cent; while the B coli averaged 243 in the crude sewage, 258 in the Imhoff tank effluent, and 39.8 in the disinfected effluent, a removal of 83.5 per cent.

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CONTENTS

Duplicating Roads vs. Widening

When a twenty-foot road becomes too narrow to carry the traffic that chooses to use it, the solution that ordinarily occurs is to widen it. Another solution that is often possible, and sometimes offers greater advantages, is to improve or build another road paralleling the first. This may cost more or, in some cases, less than widening; the latter when, for example, the original road is in a deep cut or on a high fill.

Other possible advantages of a parallel road are that it may afford more convenient access to towns or settlements which it approaches more nearly than does the original road; it may make it possible to carry through traffic around a town instead of through its business center, where the original road probably goes; and with the traffic divided between two roads, there may be less danger of accidents than with four or more lanes on a single road. Also, when it becomes necessary to repair one of the roads, or if a bridge should be washed out or the road be closed for other reasons, the parallel road can serve temporarily as a detour more acceptable, in spite of crowding, than most detours now experienced.

An illustration of such a parallel road being constructed in North Carolina is furnished by an article in this issue; while in another, New York State is said to be devoting a large part of this year's highway expenditures to the widening of it main traffic thoroughfares.

Medium-Cost Roads

In spite of the millions of dollars spent each year on hard-surface, high-cost highways, these constitute only a small percentage of the total highway mileage of the country, and probably will always continue to do so. There is a considerable mileage of country roads which do not carry enough traffic to warrant much more than grading to a passable profile and occasional dragging and crowning to prevent ruts and maintain surface drainage. Between these two lie the thousands of miles of medium-traffic roads.

These medium-traffic roads, calling for medium-cost surfacing, have been made the subject of a special study by the Bureau of Public Roads, and an investigation of methods of using light oils in treating such roads in California and Oregon was begun last year by the bureau and the California Highway Commission. An abstract of the preliminary findings of this investigation is given in this issue.

Municipal Operation of Utilities

Sales of municipal utility properties to private corporations are often cited as arguments against municipal ownership, and sales such as that referred to on another page of this issue as proof that a municipal plant can not compete in rates with a private one. This does not necessarily follow, however. The Snow Hill plant was, it is said, worn and obsolete, and it would (or should) have been replaced with modern machinery of high efficiency if it had remained in municipal control. In that event the rates could have been reduced below those that had been necessary if the old plant were to be operated without loss; and the saving to the consumers by the use of the more economical plant might easily have exceeded that effected by the changing to the com-

pany's rates, by more than the interest and sinking fund on the $31,000 received for the plant.

We would not claim that it is never a good business proposition for a municipality to sell its plant to a private company; but we do believe that a municipality might, in many cases, retain its independence and secure as satisfactory service and rates to its citizens by up-to-date management of its plant as by turning it over to a private company

Selling Municipal Utility Properties to Corporations

The Public Service Commission of Maryland recently, in rendering an opinion on the application of a Maryland company for authority to purchase a municipal power plant at Snow Hill, made the following comments:

"This Commission views with grave concern the scramble of holding companies for small, isolated and often entirely obsolete electric and other utility properties and their willingness to pay for such properties prices far beyond the cost of reproducing them. It is convinced that the prices paid in excess of the actual value of such properties comes in one form or another and in the long run out of the public's pocket. The money represented by these excessive prices is not a gift to the owners of these properties; it is paid only because the purchasers expect to make a profit out of it, either in the rates charged for service or in the sale of securities based on the stocks of the acquired properties. Such transactions do not appear to the commission to be in the public interest.

"This commission in two ways can and does protect the public from rates based on such prices: First, by requiring that any excess in the price, beyond what the commission determines as a fair value of the property, be amortized out of surplus or stockholders' profits; and, second, by establishing rates that will yield no more than a fair return on the value thus established. The commission expects to continue this policy and will scrutinize with the utmost care each proposition of the sort submitted to it. Actual and tangible benefits to the public must be shown in order to secure commission approval."

An order attached to the opinion approved the sale of the Snow Hill plant to the utility company for $31,000. But the commission recalled that two years ago the utility company offered $16,000 for the same property; this sale being held invalid, however, until it was authorized by the Legislature and approved by the commission.

"The property has acquired no additional value in two years," the opinion stated. "Why then is the company willing to pay almost twice as much at this time and another company willing to pay more than twice as much?"

Testimony of both applicants and protestants, it was recalled, was that the plant was worn and obsolete and that it would have to be rebuilt to meet present-day conditions. If a salvage value of $5,000 should be allowed, according to the commission, then the utility company is prepared to pay $26,000 and the competing company $30,250 for the privilege of serving Snow Hill with electricity. To obtain that advantage—if one exists, the opinion pointed out—the utility company is willing to write off $15,000 of the purchase price and capitalize only $16,000 as the value of the plant for rate-making purposes.

Zoning Progress in the United States

Synopsis of 1927 report by Department of Commerce. Legal status in the several states. Number of zoned cities in the several states.

The 1927 report on the progress of zoning, published with the above title by the Department of Commerce and written by Edward M. Bassett and the Division of Building and Housing, John M. Gries, chief, has recently been made public. Some of the more important features are abstracted below.

The courts generally will not uphold ordinances passed by municipalities, under the guise of zoning, which are unreasonable and discriminatory. Such was an attempt to prevent the building of a hospital for non-contagious diseases in a high-class residential district, which is held to be not an invocation of the police power for health, safety and the general welfare, but an attempted invocation of the police power for personal preferences and sentiment.

"The entire field of zoning outside of the subject of use has been upheld by the courts throughout this country. This embraces the subjects of height, area and bulk, courts and yards." Sometimes, however, a city zones before the state has passed an enabling act, or endeavors to enforce regulations not related to health, safety and the general welfare of the community. "But in every case where the municipality has been empowered to zone for height or area and has framed its regulations with some relation to access of light and air, fire protection or facility for fighting fires, the courts have upheld the ordinance."

The subject of use is holding back zoning in New Jersey, Maryland and Georgia, but elsewhere the courts now uniformly uphold zoning for use. In New Jersey the voters, by a large majority, approved in September, 1927, a constitutional amendment authorizing zoning. In Maryland the state legislature has passed a good state enabling act and it is expected that the courts will uphold it.

"Modern zoning demands just two things; a good state enabling act for zoning, and reasonable regulations in the ordinance based on the health, safety, morals and general welfare of the community.

"The state enabling act for zoning has been quite well crystallized. The Department of Commerce, Washington, and the Regional Plan of New York and Its Environs furnish all inquirers with carefully framed standard forms based on actual experience and the decided court cases. Each of these

standard or model forms contains five elements now deemed absolutely necessary:

"(1) The grant of power to regulate height, bulk, use, yards and courts and density of population;

"(2) Required preliminary consideration of the needs of each district, public hearings, and the comprehensive and impartial application of the regulations;

"(3) Requirement of more than a majority vote of the council to effect changes after written protest of property owners;

"(4) Provision for a board of adjustment with power to vary the strict letter of the ordinance and maps in cases of practical difficulty and unnecessary hardship;

"(5) Enforcement and penalties."

A board of adjustment is now considered absolutely necessary to the safe operation of a zoning ordinance. "It is the safety valve of the Zoning plan. Where there is a functioning board of adjustment to which every aggrieved applicant for a permit may resort, litigation automatically resumes the form of court review of the discretion of the board instead of out and out attacks on the constitutionality of specific instances of regulation. Consequently, where there is a board of appeals the courts become helpers in carrying out the intention of the zoning plan. They send the matter back to the board of adjustment with directions to issue a variance, the same as courts send back an excessive assessment for taxation to the board of assessors with directions to substitute a certain figure. Where there is no board of adjustment, instances are sure to arise which the courts must under the law declare unreasonable and arbitrary and therefore void.

"It is generally conceded that, if Greater New York did not have a functioning board of appeals in zoning, some specific instance of arbitrariness or unreasonableness would have gone to the courts about once a week during the last eleven years of the operation of the law. This would have meant about six hundred adverse decisions of the courts. Instead of such a result the zoning plan of Greater New York has worked smoothly for more than eleven years without a word of court criticism and without a court decision of unconstitutionality."

Since 1924, exclusion of multi-family houses from one-family detached house districts has been so generally upheld that it may be considered lawful throughout the country. The same may be said of front yard requirements.

"More than thirty million people, comprising in excess of 55 per cent of the urban population of the United States, now have the protection afforded by zoning ordinances, according to the results of a survey just completed. The 553 cities, towns and villages reported as zoned, on July 1, 1927, are well distributed throughout the country." Laws which permit municipalities to zone themselves are found in 46 states and the District of Columbia.

"Zoning ordinances have been adopted by cities, towns and villages of all sizes. Of the sixty-eight largest cities having over 100,000 population each, 52 of that number, headed by New York, Chicago, St. Louis, Boston, Baltimore, Pittsburgh and Los Angeles, have zoning ordinances in effect. The city of Cleveland, Ohio, adopted an interim zoning ordinance late in 1926, and is now preparing a comprehensive ordinance regulating the use, height and area of buildings. New Orleans, La., while it has a piece-meal zoning ordinance now in effect, is preparing a comprehensive ordinance. Louisville, Ky., is actively engaged in preparing a comprehensive ordinance. Philadelphia, Pa., and Detroit, Mich., the two largest unzoned cities, are now making zoning studies; and there are many other cities, towns and villages having zoning authority that are now seriously studying the subject."

The number of zoned municipalities in each of the states is as follows: New York, 93; New Jersey, 75; Illinois, 56; California and Massachusetts, each 54; Pennsylvania, 32; Ohio, 29; Wisconsin, 22; Michigan, 19; Indiana, 15; Connecticut, 12; Florida, Iowa and Rhode Island, 9 each; Kansas, 6; Missouri, North Carolina and Virginia, 5 each; Nebraska, 4; Colorado, Minnesota, North Dakota, Oklahoma, Oregon and Washington, 3 each; Alabama, Arizona, Arkansas, Georgia, New Hampshire, Tennessee and Utah, 2 each; and Delaware, District of Columbia, Kentucky, Louisiana, Maine, Maryland, Nevada and South Carolina, 1 each.

Public Works in the United States

Figures by Department of Commerce. Highway and street paving. Financing public works. Amounts and values of construction materials produced.

Figures concerning construction work of various kinds throughout the United States collected by various authorities seem to show that the total amount of construction work done this year up to and including July was equal to or slightly greater than the amount done during 1926, but that since the first of July there has been a slight falling off, especially in the construction of residential buildings. Complete figures naturally will not be available until after the first of the year.

Complete and detailed figures concerning construction and construction materials in the United States for the year 1926 have been collected and published by the Division of Building and Housing of the U. S. Bureau of Standards, Department of Commerce, and have recently been made public. (Which is commendably expeditious work for a Federal Department.)

The figures contained in this report show that nearly $1,100,000,000 worth of public works and public utilities were completed in 1926 as compared to about $950,000,000 in 1925. Next to Federal Government contracts, which increased 47 per cent, the largest increases were shown by sewers, bridges, and streets and roads. Water works showed a decline of 11 per cent, and contracts for excavation, drainage and irrigation decreased 31 per cent.

Although construction of and contracts let for new highways were at record levels, the number

of miles of Federal aid highways during the year dropped to 9,400 compared with 10,300 in 1925. There were under construction at the close of the year 10,050 miles under the Federal aid program as compared with 11,000 at the end of 1925, and 13,300 at the end of 1924. The Bureau of Public Roads estimated that the total expenditures for rural road purposes, including new construction and maintenance, amounts to more than $1,000,000,000 annually.

The Census Bureau reports that the 247 cities of more than 30,000 population expended in 1925 more than $317,000,000 on new outlays for streets, roads, alleys, bridges and other highway structures.

The Portland Cement Association reported that in 1926 contracts were let for 107,000,000 square yards of concrete pavement, which was 3 per cent more than in 1925 and was about one-third more than in 1923. Of this total, 61,000,000 square yards, or about 57 per cent, was in rural districts, which was somewhat less than in the preceding year.

The amount of public works and public utilities in 1926 totalled just about double the amount reported for 1921 and was nearly three times the amount reported for 1913. This was on the basis of cost, however, and a much better showing for 1913 would be made if comparison be made on the basis of amount of work done rather than money expended.

Concerning the financing of public works, the report says that "hundreds of millions of dollars worth of roads and other public works are financed each year through state and municipal bond issues, of which about $1,350,000,000 worth were floated during 1926, a smaller amount than in the two preceding years. The tendency in recent years has been for states and municipalities to pay for a larger proportion of the costs of construction from current revenues.

"The governments of states, and cities with more than 30,000 population, spent $930,000,000 from current revenues in 1925 for outlays, of which construction forms the major item. Expenditures from current revenues for outlays by the governments of states and by larger cities. for which comparable data are available, has increased rapidly," having advanced progressively from $263,000,000 in 1919 to $489,000,000 in 1922, $540,000,000 in 1923, $682,000,000 in 1924, and $835,000,000 in 1925.

Under the head of "Construction materials," the report considers these under the general headings of lumber and affiliated products; stone, clay and glass products; cement; structural steel; brick and other clay building material; glass; building stone; and sand and gravel.

Concerning lumber, it states that the estimated production of lumber in the United States in 1926 was 37,500,000,000 board feet, a slightly lower output than in 1925. Both soft wood and hard wood prices for the year averaged slightly less than in the preceding year. Movement of west coast lumber to the eastern markets of the United States continued to increase.

The value of cement manufactured has increased steadily, the value in millions of dollars having been approximately 102 in 1914, 175 in 1919, and 204, 264, and 301, in 1921, 1923, and 1925 respectively. The value is not available for 1926, but the quantity produced was about 164 million barrels in 1926 as compared to 162 million in 1925, an increase of approximately 1½ per cent during the year. Wholesale prices of cement at Chicago, as given by the report, show a steady increase from 92 cents a barrel in 1914 to $1.80 a barrel in 1920, since which time there has been a slight general decrease, reaching $1.61 in 1922, a slight rise to $1.74 in 1924, again dropping to $1.65 in 1926. The prices at the Lehigh Valley Mills show considerably greater fluctuation, from 79 cents in 1915 to a peak of $2.05 in 1920, dropping to $1.73 in 1922, rising to $1.88 in 1923 and dropping to $1.71 in 1926. Imports of Portland cement increased from 122,000 barrels in 1921 to a maximum of 3,655,000 in 1925, dropping to 3,232,000 in 1926. (It is probable that the figures for 1927 will show a still greater decrease.)

Of burnt clay materials, sewer pipe and vitrified brick are of the greatest interest in our field. The number of vitrified brick manufactured is shown to have increased from 403 million in 1918 to 699 million in 1923, dropping to 554 million in 1924 and 539 million in 1925.

In the case of sewer pipe production, the value in millions of dollars dropped from about 15 in 1913 to 11 in 1915, rose to 25 in 1920, dropped to 22 in 1921, again increased continuously to 32 in 1924 and dropped to 30 in 1925. Allowing for increase in prices, this would apparently indicate an increase in volume of about one third in the last six years.

Crushed stone, used largely for concrete and for road construction, increased from 68 million short tons in 1924 to 75.7 million in 1925, while the average price per short ton fell from $1.08 to $1.06. Stone used as curbing increased 33 per cent in volume between 1924 and 1925, or 24 per cent in value.

Gravel used for paving increased from 18 million tons in 1921 to 26 million tons in 1923, 29 million in 1924, to 32.6 million in 1925. (1926 figures are not yet available.) An even greater increase is shown in sand used for paving purposes, probably due to the increase of concrete pavement. This was from 7.5 million in 1921 to 10.7 million in 1922, to 15.6 million in 1923, 20.7 million in 1924, and 24.9 million in 1925.

Ohio Wants "Best" as well as "Lowest" Bidders

G. F. Schlesinger, director of highways and public works of the State of Ohio, in an effort to withhold highway work from irresponsible contractors, included in this year's "Information to Bidders" the following:

"Hereafter, contractors submitting bids on state highway work will be required to attach to their bids financial statements and experience and equipment questionnaires, blanks to be furnished by the State Highway Department.

"One financial statement will be sufficient from each contractor for each letting, no matter how many projects are bid on; but each bid must have attached to it an experience and equipment questionnaire, as specific questions are asked about each particular project.

"Financial statements are for the sole purpose of furnishing information to the director of highways as to whether the contractor can successfully finance the work without delay or not, and a contractor may be in proper financial condition at one letting and be 'broke' at the next.

"The information contained in the financial statements will not be made public, but will be returned to the bidder after the awards are made.

"The State is entitled to full and complete information in order to intelligently determine the 'lowest and best bidder.' There have been instances where men have been low bidders on projects who have no equipment, little money, and less experience. Awarding contracts to men like this means only inferior work, delay and the eventual 'blow-up.'

"The filing of financial statements and experience and equipment questionnaires will be mandatory, and failure to furnish these papers at a letting will be cause for rejection of the bid."

Street Lighting in Toledo

A. B. Eilenberg, electric light clerk of Toledo, Ohio, reported that on June 30 there were in service on the streets of that city 5,557 street lights, of which 3,282 were served by overhead wires and the remainder by underground wires, the latter constituting what is termed the "white-way lighting," in which there are street lights on both sides of the street, staggered at regular intervals.

The lighting bills for all of these lights during the first six months of the year total $161,564. Of this sum the city pays $61,379 and the property owners $100,185. The cost of the lighting is divided between city and owner on a fifty-fifty basis for the lights served by overhead wires and on an 85-15 per cent basis for the white-way lights. Property owners adjacent to each street light pay in proportion to the number of front feet abutting on the street, the front-foot cost decreasing as its distance from the street light increases.

Bituminous Gravel Concrete in England

The Boro of Chelmsford, England, desiring to build a durable pavement and having available within reasonable distance no stone quarries, but having large deposits of gravel, decided to use the latter material for paving if possible, and arranged with Wimpey & Co., contractors who specialize in bituminuous surfacing, to report on the project. This company took samples of gravel, made experiments in the laboratory, and on the basis of these made an offer to construct a pavement which was accepted. The pavement is described as a bituminous gravel concrete, a tar-asphalt matrix being used as a binding medium. The success of the pavement is said to depend upon obtaining a grading which will sufficiently fill up the voids so as to prevent the coarse round aggregate from rolling and thereby affecting the stability of the pavement.

It was necessary to obtain a matrix of such a penetration as would insure that the pavement would not move under traffic in hot weather and at the same time not be too brittle in winter. The gravel used was taken from a selected part of the pit and passed through a 1¼-inch screen, the grading obtained giving 67 per cent passing 1¼-inch and retained on ⅛-inch screen and leaving the remaining 33 per cent sand passing the ⅛-inch screen and grading downward. Checks gradings of the aggregate are taken daily and stocks of sand are available for rectifying any irregularity. The matrix used is known in England as Mexphalte bitumen 45 penetration, E grade, giving for summer work a penetration of about 1.30 centimeter at 25 deg. C. in 5 seconds with a standard needle.

The gravel is thoroughly dried and heated to a temperature of 200 deg. F. in an asphalt plant and mixed with the tar-asphalt matrix, which is heated in separate kettles to give a temperature of 220 deg. F. when thoroughly mixed together preparatory to being passed into the mixture. The mixed material is delivered on the road at a temperature from 180 to 200 deg. F. After being spread to the requisite thickness it is consolidated with an 8-ton steam roller and finally sealed with squeegee coat of bitumen coated with ⅜-in. pea gravel and again finally rolled. The material is laid to a consolidated thickness of three inches.

New York Highways

Six million square yards constructed this year, largely widening. Paid for from current revenues

The complete highway system of New York State contemplates about 14,000 miles of paved road. By the middle of September of this year there had been completed about 443 miles or 5,200,000 square yards of pavement construction, a large part of which was concrete. It is expected that by the end of the season the total amount of construction for the year will have been approximately 6,000,000 square yards, which exceeds the total of any previous year.

Road widening has been carried on extensively this year on the Albany Post Road, which follows the east bank of the Hudson river. Contracts providing for securing a minimum width of 27 feet, with much new road location designed to eliminate dangerous alignments and to relieve traffic conditions, were executed this year. With the possible exception of about six miles immediately south of Poughkeepsie, the Post Road will, during the coming year, have been widened throughout to a minimum of 27 feet. The Department of Public Works of the State plans to begin reconstruction of the West Shore road between New York and Albany during 1928, to be completed not later than 1930. Much widening has been done also in the Mohawk Valley route from Albany to Syracuse, continuing into Buffalo; also between Geneva and Utica, and Utica and Schenectady.

In Nassau county, the widening has been extended to give 30 feet and even 40 feet width. Jericho Turnpike is being widened to 30 feet; Conduit Boulevard will be completed next year to 40 feet width, serving to relieve the tremendous congestion of traffic on Merrick Road and Queens Boulevard. Also Montauk Highway will be widened to 40 feet as far as Patchogue, and 30 feet as far as Southampton. In Erie county, work has been started on the 40-foot pavement on the lake shore road south of Buffalo, and on the Buffalo-Millersport highway.

The replacement of old and narrow bridges became the function of the Public Works Department last year. Bridges formerly were built and maintained by the towns. The new policy is more advantageous to the State, the towns and the public at large. In many instances the work will go along hand in hand with the reconstruction, widening or straightening of highways. This will end the absurdity of traffic on fine, wide paved roads being retarded by a narrow or none too safe bridge. The new bridges are being built for permanency and are attractive in design. Many of them have been relocated when rebuilt, with the purpose of eliminating curves or grades or otherwise accelerating instead of retarding traffic.

On most of the trunk lines and on some of the less important highways, the department has made much progress in curve straightening and elimination of grades. Often the realignment of roads accompanied the reconstruction of new bridges and also the elimination of grade crossings and steep grades on curved hills, not only saving distance, but effecting a degree of safety lacking in the old roads.

The highway system of the state was started with two bond issues of $50,000,000 each. Practically all of these bonds were exhausted by the close of the construction season of 1922. Since that time, highways have been constructed, reconstructed, and maintained almost entirely from current revenues. The total amount spent on highway improvements during the year 1927 is estimated at $38,500,000. In 1926 it was a little over $36,500,000; in 1925 about $35,400,000; in 1924, $31,270,000; and in 1923, $24,750,000. Of this year's total, $18,000,000 was for reconstruction and maintenance, $6,000,000 was to meet the Federal Aid appropriation; while counties contribute 35 per cent of the cost of all newly constructed county highways and 35 per cent for the reconstruction of bridges; and many counties voluntarily contribute 35 per cent of the cost of reconstructing roads.

Dumping New York's Garbage at Sea

A large part of the garbage and rubbish from the various boroughs of greater New York is now carried several miles to sea and dumped, and it has been a continuing complaint for years from residents on the Long Island and New Jersey coasts that much of this is washed on to the bathing beaches over a stretch of miles east and south of New York City.

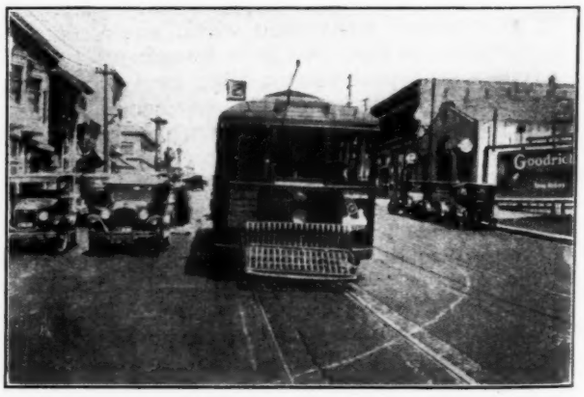
In 1926, 7,433 bottles were set adrift with the material dumped at sea by the Committee on Main Drainage of New York to determine the drift of such material. The first of these were set adrift in July 1, and the last on July 27. By January 1, 1927, of the 7,433 set adrift 2,283 had been reported found, and during the next 6 months 136 more. This gives a total of 32½ per cent of all of those set adrift. 909 bottles were found on the beaches of Long Island, having reached there in quantity in about 4 days; 55 were found in lower New York Bay, reaching there in 14 days; one on Staten Island in 12 days; 550 along the New Jersey coast in 10 days; 186 in Delaware in 46 days; 97 in Maryland in 63 days; 345 in Virginia in 60 days; 257 in North Carolina in 71 days; 14 were picked up at sea, and 5 were found on the west coast of Ireland 9½ months after being set afloat. The most southerly point at which a bottle has been recovered is Cape Lookout, North Carolina, about 50 miles south of Cape Hatteras. Another was recovered on the North Carolina coast about 25 miles west of Cape Lookout.

Undoubtedly a great many bottles were stranded which have not been reported, since the only way of knowing of their stranding was the return to the committee of post cards, one of which was placed in each bottle, which were mailed by the finders of the bottles if they thought it worth while to take the trouble. More than 12 per cent of the bottles set afloat were reported from the Long Island beaches, most of them having reached there within 4 or 5 days after having been set afloat.

The New York authorities have from time to time stated positively that no garbage dumped by them returns to the beaches of Long Island and New Jersey, but those who are familiar with the facts had what seems to be undoubted proof of this, even before the test with the floating bottles. For instance, the writer has found on one Long Island beach during the past few years, scores if not hundreds of worn creosoted wood paving blocks. It is believed that no cities in this vicinity except New York and Newark use wood paving blocks in any quantities, and it is not evident how those from Newark could possibly have reached the beaches. The conclusion seems to be inevitable that these blocks came from the city of New York. When found, they were almost always surrounded by miscellaneous collections of rubbish, lemon skins, watermelon rinds and other miscellaneous garbage matter.

Widening Streets in San Francisco

Reduction of sidewalk widths and consequent widening of the roadway has served to increase traffic facilities on many main thoroughfares in San Francisco, Cal. By this method, Geary street from Van Ness avenue to Mason street has been widened 6 feet between curbs. A similar improvement under way will provide another traffic lane for vehicular travel on Kearny street from Market street to Columbus avenue. Also the widening of Union street from Franklin street to Steiner street, and the widening of Clement street from Arguello Boulevard to Funston Way will be accomplished by narrowing of sidewalks.



WIDENED PAVING ON CLEMENT ST., SAN FRANCISCO

contracts having been awarded for both improvements. The setting back of curbs on these streets, all of which carry double car tracks, has provided in each case a traffic lane of ample width between the cars and parked vehicles.

Paralleling a North Carolina Highway

County highway builds eight and a half miles of twenty-foot concrete pavement to relieve traffic conditions on a state highway

By John D. Topping

North Carolina State Highway No. 69, which traverses the western portion of the state, is a national highway link which at Asheville connects with five or more north and south routes. The northern branches of these highways spread fanwise through the North, East and Middle West and carry to Asheville and the section known as the "Land of the Sky" the southbound tourist traffic of the wide and populous region which they serve as tourist routes. South of Asheville the highway connects with roads which lead to Savannah, Charleston, Atlanta and the cities of Florida. The road is, therefore, the narrow point in an hour glass of constantly flowing motor traffic. Between Asheville, N. C. and Hendersonville, N. C., this traffic is unusually heavy.

Early in 1927 Buncombe county officials authorized the construction of a road which would parallel the state highway and relieve the congestion. This route, which is eight and one-half miles long and is at no point more than a mile from the state highway, has greater width of pavement and offers somewhat better grades than the older road, which has been in use almost a decade.

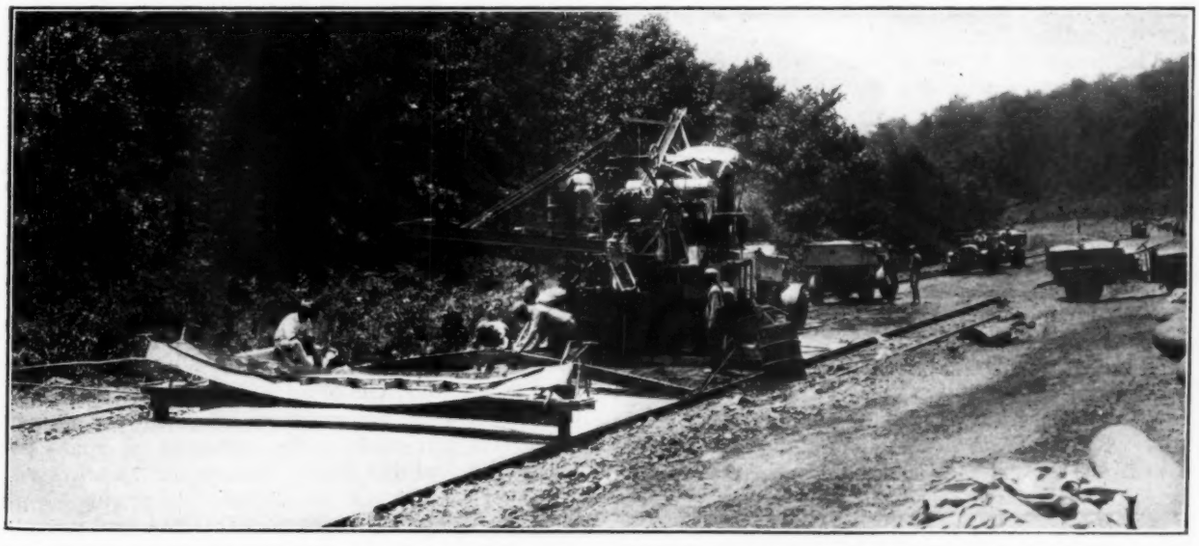
A parallel route rather than a widening of the present pavement was resorted to, since the new road is a county project and since it also serves a territory now rapidly expanding with residence and suburban communities. The results of the division of traffic between the two highways will be a fertile source of information to highway engineers.

In anticipation of a large expansion of the population in the section through which this road extends, water mains have been laid and fire hydrants set, it being the policy of the city of Asheville and Buncombe county, jointly, to serve all of the communities in the county with water lines.

The new road begins at Biltmore, a suburb of Asheville, and extends southward to Arden, N. C., near the Buncombe county boundary, where the new road joins the state highway, passing through South Biltmore (an incorporated village), Buena Vista, Busbee, Skyland, and the development of Royal Pines. Two crossings of the main line of the Southern Railway between Asheville and Spartanburg, S. C., are being made, at one point by an underpass and at the other by an overhead crossing. It has been the policy for a number of years in North Carolina to eliminate as far as possible all grade crossings on newly constructed highways.

Contracts for the construction of this highway were let to the Howerton Engineering Company, of Asheville. Sub-contracts for grading were let by that company to the W. H. Anderson Construction Company and Gamble Brothers, both of Asheville. Five and one half miles of the right of way were graded by the former concern and the remainder by the latter. All bridge work and drainage is being done by Howerton with the exception of the underpass, which is being constructed by the Southern Railway.

The right of way for the new highway has been well chosen. At no point does the grade exceed 5½ per cent; curves have been eliminated as far as possible and all have been super-elevated from 9 inches to 18 inches, depending upon the degree of curvature. Cuts and fills were made by means of steam shovels, trucks, dump wagons and wheelers: leveling and grading by means of fresnos, finished by hand and rolled with a 6-ton gasoline roller.



GENERAL VIEW OF PAVING OPERATIONS ON A WESTERN NORTH CAROLINA HIGHWAY

SETTING FORMS IN ADVANCE OF PAVING

The concrete pavement is 20 feet wide and the highway grade was constructed 36 feet wide in the cuts and 40 feet in the fills, thus providing ample shoulder width for the highway. It was necessary to construct five concrete culverts to properly drain the road.

When the steel forms have been set in place along the roughly levelled stretch, the fine grading is done by hand; a form board, supported at the ends on the forms, being used as a guide in advance of the paving machine and all irregularities of the subgrade surface remedied. The surface is checked for grade immediately behind the mixer.

The Howerton Engineering Company uses Mack and Ruggles trucks in transporting material to the paving machine, a Barber-Greene loading machine being used to load the trucks. Large supplies of No. 2 stone, sand, and cement are kept on the graded highway in advance of the paving machine, the stone being brought from the company's source of supply by means of trucks to strategic points and loaded into trucks to be transported to the mixer as needed. The loading machine is mounted upon a caterpillar tread and moves from place to place under its own power. At the paver, the trucks are reversed and dumped into the hopper. Sand and cement are brought to the hopper by means of barrows.

The paving machine used is a Rex 21 E, handling a half-yard of a 1:2:3 mixture at one charging, and placing it on the roadbed by means of a clam bucket and a horizontal crane. Seven hundred and sixty feet of paving 20 feet wide and 7 inches thick laid in an eight-hour day is the record of the crew on this contract. The average day's work is around seven hundred feet.

The pavement is being built twenty feet wide, which is two feet wider than Highway No. 69.

LOADING MACHING LOADING TRUCK WITH STONE

LEVELING AND WORKING THE WET CONCRETE

Blaw-Knox forms are used. Construction joints are built into the road at the end of each day's work, reinforced with round steel bars ¾ inch in diameter.

Two per cent of liquid calcium chloride is added to the mixture, as a result of which it is necessary to keep the new work wet for only twenty-four hours after it has been laid. Burlap is laid on the new stretches as soon as possible, and is removed after the concrete has been down twenty-four hours.

As the concrete is poured it is worked over by hand by a crew using shovels and wearing rubber boots, care being taken that no mud or other foreign material be carried into the wet concrete on the boots. This forces the coarser aggregate down and brings the finer to the surface. Following this, a smoothing board twenty feet long fitted with handles at both ends is used.

Fifty men on the average are employed by the contractors on the highway. In addition to the truck drivers and muleteers employed in the general work of grading and transporting material, two men are employed on the paving mixer and an additional man to supervise the loading of the hopper. Three form setters keep the forms set for one hundred to one hundred and fifty feet in advance of the paving machine. One subgrader, aided by the form board, subgrades the road bed, keeping his work finished well in advance of the paving machine. Five men work over the concrete, evenly distributing the mixture as it is dumped on the road bed and working down the heavier material by means of shovels. Two smoothers work the smoothing board and cover the new work with burlap as soon as the surface has set slightly and the edges of the pavement have been trowelled. A rounded corner is formed on the edge of the road by one of these men using a trowel, this being done as soon as the concrete has set sufficiently. One man operates an Acme gasoline roller to smooth the rough-graded surface of the subgrade in advance of the form setters. Two operators are constantly employed on the loading machine at the rock dump; one overseeing the loading of the trucks from the hopper of the machine while the other supervises the operation of the chain of buckets.

The underpass by which the highway will cross the Southern Railway right of way is being constructed by the railroad company. It will be built of concrete and will provide for a roadway thirty-three feet wide; the extra width being for greater safety for motorists. The concrete overpass by which the highway again crosses the railway will be constructed by the Howerton Engineering Company at Arden, with a length of 47 feet and a roadway width of twenty feet.

Recent Legal Decisions

PAVING BONDS HELD VALID NOTWITHSTANDING IRREGULARITY OF PROCEDURE

In an action by a holder of municipal paving bonds and coupons with which the city had paid the contractor to establish the validity of the bonds, the main questions were concerned with the legality of the proceedings leading up to the issuance of the bonds. The court said: "As there was lawful power on the part of the city to issue the obligations of the city to pay for the work done by the contractor, Beebe, and as this work was done by the contractor for the city to the satisfaction of the city, and was accordingly accepted by the city, and these bonds involved in this action were made and issued by the city in pursuance of lawful statutory power," and were by the city employed in discharging its debt to the contractor, and when so issued by the city they contained the recitals above quoted, insuring the intended purchaser or owner of the same that all preliminary steps had been taken in manner and form as by law required, if it should be now ascertained as a fact that these recitals are untrue, the city would, and of right ought to be, estopped to so contend or prove.

"Even should the city be successful in its attempt to repudiate the bonds in suit, it would not thereby benefit its condition, for in such event, not having paid the contractor for what it has received and is using, he or his assigns would be entitled to the money earned under the contract owed by the city on the paving contract."

The recitals in the bonds referred to were to the effect that "all conditions, things and acts required by law to exist, to be or to be done, precedent to and in issuing of this bond have been, have existed and have been performed in due form and time, and that the indebtedness of said city, including this bond, does not exceed any limitation imposed by law."

The bonds were held valid.—South Sioux City v. Hanchett Bond Co., Circuit Court of Appeals, Eighth Circuit, 19 Fed. (2nd) 476.

MATERIALMAN'S REMEDY WHERE GOVERNMENT CONTRACTOR FAILS TO GIVE BOND IS ACTION FOR DAMAGES FOR BREACH OF PROMISE TO GIVE BOND

The contractor for the construction of a hospital in the City of New York for the United States government undertook but failed to give the bond required by Act of Congress Aug. 13, 1894, as amended Feb. 24, 1905. A materialman who supplied labor and materials to a subcontractor, and would have had the benefit of the bond, remained unpaid, the subcontractor having made default. He sued the contractor, in the City Court, and the question arose as to his remedy, if any, against the contractor.

The City Court held there was no remedy whatever. New York Appellate Term held the contractor's obligation was independent of the bond, which was only important as defining the procedure in an action on the bond against the surety, (126 Misc. 690). The Appellate Division reversed this decision, holding the proper remedy was an action in the federal courts, the procedure to be the same as if the bond were in existence, (218 App. Div. 163, 218 N. Y. Supp. 51). The New York Court of Appeals reversed the Appellate Division and affirmed the Appellate Term.

The Court of Appeals holds that the promise to give a bond is not a bond or its equivalent. But the promise cannot be broken with impunity. A laborer or materialman for whose protection it was given has a right of action for the damages resulting from the breach. "The promise was exacted by the promisee in fulfillment of a legal duty. It was exacted for the very purpose of assuring to the plaintiff and to others similarly situated the benefit of the security established by the statute. Within the narrowest interpretation of the rule in Lawrence v. Fox, a beneficiary thus related to the promise has a standing to enforce it. Something more is here than an indirect or collateral advantage, a lucky find or windfall, the accidental consequence of a promise conceived for the good of some one else. Security to materialmen and laborers was the end and aim of the transaction. If the promise was not for them, it was without significance or reason."

"There is little basis for the defendant's fear that its final liability, enforced in successive lawsuits, will be greater in the aggregate than the penalty of the bond. The plaintiff alleges in his complaint that by the failure to give the bond he has been damaged in the sum of $1,739.34 with interest, the unpaid balance of his bill. He must prove his damages or fail. His recovery cannot exceed in any event the pro rata share that would be his if a bond of $5,500 had been given in fulfillment of the promise. Proof of his own demand will be sufficient in the first instance to cast the burden upon the other side of going forward with the evidence. The defendant will then be at liberty to show in reduction of the damages that other claimants, still unpaid, may share in the security. The aggregate liability to all must be within the limit of the penalty. Strong v. American Fence Const. Co., 245 N. Y. 48, 156 N. E. 92.

PASSING OF TITLE TO ROAD MACHINE SOLD ON APPROVAL

A road machine was delivered to a highway contractor on approval. If he found it satisfactory after trying it out, he was to keep it and pay for it. No time was fixed for the return of the machine, if not satisfactory. The machine was used for one year and four months on two road construction contracts. After its return was twice demanded action was begun for the selling price. The New York Appellate Division held, Brown & Lowe Co. v. Potolski, 223 N. Y. Supp. 71, that a verdict was properly directed for the plaintiff. Notwithstanding New York Personal Property Law, §100, rule 3, subd. 2, providing that what is a reasonable time before the title to property delivered on approval passes to the buyer is a question of fact, in this case it was a question of

law. As a matter of law the title to the machine passed to the defendant since there could be no conflicting inferences drawn as to whether the delay was reasonable. Defendant's claim that the machine was unsatisfactory was not proven, but, if proven, it would have been no defense under the undisputed facts.

CONTRACTOR COMPELLING PERFORMANCE OF CONTRACT CANNOT RECOVER THEREUNDER AND ALSO RECOVER DAMAGES FROM REPUDIATION

As a general rule, where either party to a construction contract repudiates it before work has begun, the injured party may either (1) keep the contract alive for the benefit of both parties, being at all times ready and able to perform, and at the end of the contract time for performance sue and recover under the contract, or (2) treat the repudiation as putting an end to the contract for all purposes of performance, and sue for the profits he would have realized if he had not been prevented from performing.

A paving company, employed by a municipality to grade and pave certain of its streets at stipulated unit prices, was refused permission to do the work. It obtained a decree in chancery enjoining the municipality from interfering with it in the performance of the work "up to the amount of" the funds legally at the town's disposal. Thereafter it performed work which, under the terms of the contract, amounted to the total sum of such legally available funds. The West Virginia Supreme Court of Appeals held, in an action by the paving company, that it was not entitled to recover an additional sum as damages resulting from delay in the performance of the work due to the town's attempted repudiation of the contract. Atlantic Bitulithic Co. v. Town of Englewood, 137 S. E. 223.

WHERE PROPERTY IS BENEFITED BY CHANGE OF GRADE

The Georgia Court of Appeals holds, City of Winder v. Wood, 137 S. E. 107, that the measure of damages in an action against a municipality for damage to the plaintiff property owner as a result of the change in the grade of an adjacent street is the difference between the market value of the property before and after the change in the grade. The plaintiff would not be entitled to recover if the property was, by reason of the paving, benefited or enhanced in value in an amount greater than the amount of damage caused by the change of grade.

ALTERATION OF ROAD CONTRACT NOT RELEASING SURETY

A contract may be modified by adding provisions which do not change the legal effect of those contained in the original document. The change of a subcontract for part of the construction of a highway so as to include extra work which did not materially vary the contract so as to prejudice the surety, was held not to affect the surety's liability on the bond for faithful performance, whether the subcontract was altered before or after the bond was delivered to the subcontractor. New Amsterdam Casualty Co. v. W. T. Taylor Const. Co., C. C. A., 5th circuit, 12 Fed. (2nd) 972.

DATE OF FINAL SETTLEMENT OF GOVERNMENT CONTRACT

The act of the chief engineer of the bureau of public roads, or his deputy, in approving the estimate prepared by the district engineer according to the established administrative methods of the department, is the final adjustment and settlement of a contract for public works, providing for final payment within 30 days after approval of the final estimate, and the "final settlement of the contract" within U. S. Comp. St. Sect. 6923, requiring suit within one year after "final settlement." Southern Surety Co. v. Western Pipe & Steel Co., C. C. A., 9th Circuit, 16 Fed. (2nd) 456.

MATERIALMAN'S CLAIM ON CONTRACTOR'S ESTATE APART FROM CONTRACT

The New York Appellate Division holds, Laski v. State, 217 App. Div. 420, 217 N. Y. Supp. 48, that a bond given to the state to secure performance of a public work is solely for the protection of the state. Where the surety completes on the contractor's default, it is subrogated to the state's rights and is not liable to an assignee of the contractor's claims for sums due on the contract. But a materialman who furnished material to the contractor which went into the construction had a claim, not arising from contract, against sums due from the estate superior to that of the surety; the expense to the surety being diminished to the extent of the material furnished.

FINANCING OF ROAD CONTRACT

A bank financed a contractor who took from the original contractor an assignment of a road contract with a county at 90 per cent. of the contract price. The assignee or subcontractor gave an order on the original contractor to pay all money coming to him to the bank. The order was accepted by the original contractor and filed with the county auditor. The bank advanced more than it received under the assignment, plus the final estimate remaining unpaid by the county at the completion of the contract. In a controversy between the bank and the original contractor, the Minnesota Supreme Court held, Farmers' & Merchants' State Bank v. S J. Groves & Sons Co., 210 N. W. 37, that the trial court correctly gave the bank 90 per cent. of such final estimate as against the original contractor's claim thereto.

CONTRACTORS' LIABILITY FOR DAMAGE BY BLASTING

Where one, in the carrying on of blasting operations, throws rocks or debris on another's property, he is liable for the damage done on the principle that he is guilty of trespass, and quite irrespective of the question of his negligence.

Where blasting operations in highway construction were intrinsically dangerous, it was held that the principal contractor was liable for the damage done by the subcontractor.

Whether or not the road district was liable for such damage under the law of North Carolina was not decided. Irrespective of the district's liability, it was held the contractor and subcontractor were liable. Asheville Const. Co. v. Southern Ry. Co., C. C. A., Fourth circuit, 19 Fed. (2nd) 32.

NEWS OF THE SOCIETIES

Nov. 7-9—NORTH CAROLINA SECTION, AMERICAN WATER WORKS ASSOCIATION. Meeting at Durham, N. C.

Nov. 14-18—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Thirty-third annual convention at Dallas, Tex.

Nov. 28-Dec. 2—ASPHALT PAVING CONFERENCE. Sixth annual conference at Atlanta, Ga.

Dec. 1-2—HIGHWAY RESEARCH BOARD, NAT'L. RESEARCH COUNCIL. Annual meeting at Washington, D. C.

Dec. 7-8—NATIONAL RIVERS AND HARBORS CONGRESS. Annual convention at Washington, D. C.

Jan. 9-10—INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS. Annual convention at Detroit, Mich.

Jan. 9-14—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual convention and road show at Cleveland, O.

Jan. 19-21—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting at New York City.

Jan. 23-27—ASSOCIATED GENERAL CONTRACTORS. Annual convention at West Baden, Ind.

NATIONAL CONSTRUCTION EXPOSITION

The National Construction Exposition will be held Jan. 23-27, 1928, in the West Baden Springs Hotel, West Baden, Ind., coincident with the ninth annual meeting of the Associated General Contractors. Materials, supplies, equipment and machinery essential to America's seven billion dollar 1928 general construction business will be displayed. Every important method used throughout the general construction industries will be shown in a series of exhibits which will demonstrate all types of construction materials, supplies and accessories for industrial, engineering, govenmental, transportation and specialty building project.

The show will open officially at 9.30 a. m. daily. Official evening closing hours will vary in accordance with the entertainment program of the Association. Installation of displays will begin Friday, January 20th. Dismantling will take place at a sufficiently early hour to allow many exhibitors' representatives to leave late Friday evening, January 27th.

The most recent inclusive figures available—for 1925—indicate that the volume of operations of the membership of the A. G. C. of A. alone reached $2,294,000,000 in a year. Construction is America's second greatest industry—being exceeded in volume of operations only by agriculture.

The general offices of the Exposition are at 225 West 34th Street, New York City. Following are the officers of the Associated General Contractors of America:

President, Sumner Sollit, president of Sumner Sollit Co., Chicago; vice president at large, Leonard G. Wason, president of Aberthaw Co., Boston; treasurer, Lee Paschall, vice president of Wise Granite & Construction Co., Richmond, Va.; general manager, General R. C. Marshall, Jr., Washington, D. C.; secretary, Colonel D. H. Sawyer, Washington, D. C.

Vice Presidents: Godfrey Edwards, president Edwards, Wildey & Dixon Co., Los Angeles, Cal.; Henry Ericsson, president Henry Ericsson Co., Chicago; John Wise, president Wise & Upson, Hartford, Conn.; George Watson, president The Watson Co., Dallas, Texas; Henry H. Wilson, managing partner, Winston Bros. & H. H. Wilson, Harrisburg, Pa.; Walton A. Snow, president, Sandquist & Snow, Miami, Fla.; H. P. Treadway, Kansas City Bridge Co., Kansas City, Mo.; George W. Gauntlett, Grays Harbor Construction Co., Hoquiam, Wash.

Directors: D. A. Garber, president North-Eastern Construction Co., New York City; W. A. Rogers, president Bates & Rogers Construction Co., Chicago; Arthur A. Bent, partner, Bent Brothers, Los Angeles, Cal.; John W. Cowper, president John W. Cowper Co., Buffalo; Frederick L. Cranford, president Frederick L. Cranford Co., Brooklyn; George B. Walbridge, vice-president, Walbridge-Aldinger Co., Detroit; J. H. Ellison, vice president, Winston-Dear Co., Minneapolis, Minn.; J. S. Crinkley, president Crinkley Construction Co., Memphis, Tenn.; C. W. Lundoff, president, Lundoff-Bicknell Co., Cleveland, Ohio; Eric Ryberg, president Ryberg Bros., Salt Lake City, Utah; E. R. Shenk, assistant to president, Henry Shenk Co., Erie, Pa.; L. P. Slattery, president, Slattery & Henry, Inc., Greenville, S. C.; James E. Cashman, Burlington, Vt.; J. M. Clifton, president Clifton, Applegate & Toole, Spokane, Wash.; D. B. Fogles, vice president and general manager, Fogles Construction Co.; Minneapolis, Minn.; Walter H. Gahagan, president W. H. Gahagan, Inc., Brooklyn; Robert J. Potts, Potts & Prentice, Waco, Texas; T. J. Baker, vice president Coddington Engineering Co., Milwaukee, Wis.; W. A. Bechtel, San Francisco; J. W. Harris, Hegeman-Harris Co., New York City; W. R. Hughes, Jr., Hughes-Foulkrod Co., Philadelphia; J. W. Mann, Oklahoma City, Okla.; W. O. Winston, chairman Board of Directors, Winston Bros. Company, Minneapolis, Minn.; H. S. Tullock, president, Missouri Bally Bridge & Iron Co., Leavenworth, Kansas.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS

The thirty-third annual convention of this association will be held at Dallas, Tex., Nov. 14-18, with headquarters at the Baker Hotel. The program of the meeting follows:

Monday: Morning—Registration; Afternoon—Meeting of executive committee, and of committees on brick pavements, subgrades and foundations, cement concrete pavements, sewers, street railway and track construction, stone block pavements, municipal contract forms, bituminous pavements, and sidewalks and curbs; Evening—Formal opening of the convention, and report of officers and committees.

Tuesday: Morning— City Planning Committee Report, W. W. De Berard; The Plan for Greater Dallas, E. A. Wood; Errors to Avoid in City Planning, J. L. Crane, Jr.; and discussion by G. W. Hayler and G. H. Herrold; Municipal Legislation and Finance Committee Report, W. B. Fowler; Cash Policy for Municipal Improvements, Richard Biehl; The Cincinnati Plan for Programming Public Improvements, J. B. Blandford, Jr.; Afternoon—Reports of Specification Committees and of American Society for Testing Material, National Research Council, U. S. Department of Commerce, Division of Simplified Practice, America Engineering Council and American Engineering Standards Committee.

Wednesday: Morning— Street Paving and Street Design Committee Report, Bryson Vallas; Rigidity vs. Resiliency and Flexibility, George C. Warren; Importance of Curing Concrete Base and Advantages of Testing Concrete on the Job, H. F. Clemmer; The Salvaging of Broken Stone and Gravel Roads with Asphaltic Wearing Surface, W. H. Rhodes; A Study of European and American Rock Asphalts, Victor Nicholson; Natural Limestone Rock Asphalt and Its Use, W. J. Doyle; Street Maintenance, Street Cleaning and Snow Removal Committee Report, A. Prescott Folwell; Report of Nominating Committee and election of officers.

Afternoon and Evening—There will be a specially conducted trip to Fort Worth, leaving at noon. The trip will be made in interurban cars, with luncheon en route. At Fort Worth, the itinerary will include the sewerage treatment plant, the municipal aviation fields, Lake Worth and Lake Worth Dam, the water conduit tunnel and filtration plant. A barbecue will be provided at Lake Worth.

Thursday: Morning—Chlorination of Chicago's Water Supply, A. E. Gorman; Recent Improvements in Filtration, John R. Baylis; Results of Water Waste Survey, L. A. Quigley; Two Main Systems of Water Distribution, Thomas F. Wolfe; Use of Centrifugally Cast Pipe, and Probable Question of Increased Use Relative to Ordinary Cast Pipe, Lester A. Long; Summary of Water Works Matters, John B. Hawley.

Afternoon: Street and Traffic Lighting Committee Report; Street Lighting and the Municipality, L. A. S. Wood; Speed and Safety with Traffic Control and Light, A. F. Dickerson; Sewerage, Sanitation and Garbage Disposal Committee Report, Robert Cramer; Economic Aspects of the Activated Sludge Process, Robert Cramer

and John A. Wilson; Gas Collection, Its Possibilities and Value in Separate Sludge Digestion, Jerry Donahue; Sludge Digestion, Dr. Willem Rudolfs; Report of resolutions committee and other new business. Evening —Annual Banquet.

AMERICAN ROAD BUILDERS' ASSOCIATION

The nominating committee of the American Road Builders' Association have made the following nominations for officers for the year 1928-29: For president, R. Keith Compton, director, Department of Public Works, Richmond, Va. For vice-presidents: W. A. Van Duzer, assistant chief engineer, Pennsylvania Department of Highways, Harrisburg, Pa.; D. B. Dimick, president, American Casting Co., Birmingham, Ala.; S. F. Beatty, president, The Austin-Western Road Machinery Co., Chicago, Ill.; Samuel Hill, Hon. life president, Washington State Good Roads Association, Seattle, Wash. For treasurer: James H. Macdonald, consulting road and paving expert, New Haven, Conn. For directors, Term ending 1931: H. K. Bishop, chief, Division of Construction, U. S. Bureau of Public Roads, Washington, D. C.; W. S. Godwin, W. S. Godwin Co., Baltimore, Md.; P. L. Griffiths, American Tar Products Co., Pittsburgh, Pa.; W. R. Neel, state highway engineer of Georgia, East Point, Ga.; J. E. Pennybacker, general manager, The Asphalt Association, New York, N. Y.; T. J. Wasser, supervising engineer, Hudson County Board of Chosen Freeholders, Jersey City, N. J.; S. M. Williams, manager, The Autocar Sales and Service Co., Chicago, Ill.

As a contribution to highway safety, and in order to increase interest and collect ideas that will be of value in solving the highway safety problem, the American Road Builders' Association is offering $1,000 in prizes for the best ideas for increasing street and highway safety. The contest is open to everyone; a contestant may submit a complete thesis on Highway Safety, or a description of an individual idea.

A complete report compiled from the plans of the contestants will be presented at the convention of the Association to be held in Cleveland, O., January 9-13, 1928, and the awards will be announced by radio and through the press at that time.

Manuscripts must be submitted by midnight, November 15, 1927, addressed to Chas. M. Upham, Director, American Road Builders' Association, Washington, D. C.

NATIONAL MALARIA COMMITTEE

The meeting of the National Malaria Committee will be held at Memphis, Tenn., Nov. 16 and 17, in conjunction with the annual meeting of Southern Medical Association. The program of the meeting is as follows:

Wednesday Afternoon, Nov. 16—"Observations of the Length of Life of Anopheles Inodrimaculatus after Commencing Control of Production," by Dr. L. L. Williams and A. E. Legare; "Some Recent Investigations on Malaria in the Irrigated Regions of New Mexico," by Dr. M. A. Barker; "Malaria Control," by Dr. Wm. E. Deeks; "Alimentation of Anopheline Larvae and its Relation to Their Distribution in Nature," by Dr. M. F. Boyd and Miss Helen Foot.

Thursday Afternoon, Nov. 17—"What the Haciendero Can Do to Reduce Malaria," by J. J. Mieldazis; "Experience with Plasmochin in the Treatment of Malaira," by Dr. Wm. Krauss; "An Indictment of Chronic Malarial Infection with a Plan for a Realistic Attitude," by Dr. George M. Murray; "Methods and Costs of Screening Farm Tenant Homes in Mississippi," by Dr. C. P. Coogle. There will be discussions of these by J. A. Le Prince, R. E. Tarbett, H. A. Johnson and A. H. Fletcher.

"Malaria in Palestine, 1922-25," by Dr. Paul S. Carley; "Airplanes and Paris Green in Control of Anopheles Production, by Dr. L. L. Williams. Reports from health officers will follow the presentation of papers.

The officers of the Committee are: Dr. L. O. Howard, honorary chairman; Dr. Victor G. Heiser, chairman; Dr. F. J. Underwood, vice-chairman; Dr. L. D. Fricks, secretary; Dr. L. L. Williams, acting secretary.

ASPHALT PAVING CONFERENCE AT ATLANTA

The Sixth Annual Asphalt Paving Conference will be held at the Atlanta-Biltmore Hotel, Atlanta, Georgia, under the auspices of The Asphalt Association and The Association of Asphalt Paving Technologists, during the week of November 28th. It will be attended by engineers, officials, asphalt research specialists, contractors and manufacturers.

Thomas H. MacDonald, chief of United States Bureau of Public Roads, is listed as one of the outstanding speakers. He is expected to stress the great national problem of conserving the vast mileage of highways already constructed through some method of resurfacing which will utilize the full foundation value of the old pavements, as into the construction of these pavements has gone the immense investment of some $8,000,000,000. Col. Woolsey Finnell, director of highways of Alabama, is chairman of the Engineering Committee, which includes state, city, county and research engineers throughout the United States, including J. T. Bullen, parish engineer, Caddo Parish, Shreveport, La.; Harwood Beebe, consulting engineer, Spartanburg, S. C.; R. Keith Compton, director of public works, Richmond, Va.; J. H. Dingle, city engineer, Charleston, S. C.; Jay Downer, chief engineer of Westchester County Park Commission, Bronxville, N. Y.; G. F. Fisk, first assistant city engineer, Buffalo, N. Y.; W. B. Fowler, city engineer, Memphis, Tenn.; Capt. James M. Garrett, city engineer, Montgomery, Ala.; W. S. Hawkins, Harrison County engineer, Gulfport, Miss.; G. H. Henderson, chief engineer, Rhode Island State Board of Public Works, Providence, R. I.; J. B. Hittell, chief engineer, Board of Local Improvements, Chicago, Ill.; W. W. Horner, chief engineer, Sewers and Streets, St. Louis, Mo.; Col. J. M. Johnson, consulting engineer, Marion, S. C.; J. N. Mackall, chr. and chief engineer of State Road Commission, Baltimore, Md.; W. R. Neel, state highway engineer, East Point, Ga.; W. C. Olsen, consulting engineer, Raleigh, N. C.; P. C. Painter, city manager, Greensboro, N. C.; W. O'D. Rockwell, city engineer, Savannah, Ga.; H. L. Shaner, commissioner of public works, Winston-Salem, N. C.; H. B. Smith, Burlington County engineer, Mt. Holly, N. J.; R. M. Smith, deputy minister of highways, Toronto, Ont., Canada.; Bryson Vallas, city engineer, New Orleans, La.

Francis P. Smith, consulting engineer, of New York City, is chairman of the Research Committee. Associated with him are T. R. Agg, professor of highway engineering, Iowa State College, Ames, Iowa; A. R. Ebberts, engineer of tests, Allegheny County, Pittsburgh, Pa.; W. J. Emmons, research specialist, United States Bureau of Public Roads, Washington, D. C.; Roy M. Green, manager of Western Laboratories, Inc., Lincoln, Neb.; H. L. Howe, Jr. director, Municipal Testing Laboratory, Rochester, N. Y.; Prevost Hubbard, chemical engineer, The Asphalt Association, New York; L. M. Law, chief chemist, New Orleans Refining Co., New Orleans, La.; C. A. Mullen, consulting engineer, Montreal, Canada; Hugh W. Skidmore, president, Chicago Paving Laboratory, Chicago, Ill.; C. H. Underwood, city chemist, Indianapolis, Ind.

L. B. West, president of the West Construction Company, Chattanooga, Tenn., is chairman of the Contractors' Committee, consisting of B. N. Belcher, president, Belcher Asphalt Paving Co., Inc., Miami, Fla.; I. N. Bransfield, Chicago, Ill.; E. T. Davis, Standard Paving Co., Toronto, Ont., Canada; W. S. Ely, president, Ely Construction Co., Augusta, Ga.; Sam E. Finley, Atlanta, Ga.; Wm. P. McDonald, president, Wm. P. McDonald Construction Co., Flushing, N. Y.; B. S. Russel, secretary, Cuyahoga Asphalt and Paving Co., Cleveland, Ohio; W. R. Smith, president, Lane Construction Company, Meriden, Conn.; R. B. Tyler, president, R. B. Tyler Co., Inc., Louisville, Ky.; Joe L. Blythe, Blythe Brothers Co., Charlotte, N. C.; J. H. Cranford, president and treasurer, The Cranford Co., Washington, D. C.

W. A. Hansell, Jr., chief of the Department of Construction, Atlanta, Ga., is chairman of the Local Committee. That the social aspect of the convention is to have equally distinguished management is indicated by the fact that Bobby Jones, greatest golfer of all time, will be active in the arrangements for the Golf Tournament, and will play an exhibition match with Watts Gunn, almost equally famous.

(Continued on page 46)

New Appliances

Describing New Machinery, Apparatus, Mate rials and Methods and Recent Interesting Installations

NON-CLOGGING SEWAGE PUMPS

The Morris Machine Works, Baldwinsville, N. Y., manufactures a type of pump designed especially to handle raw sewage, pulp, trash and other liquids containing solid or semi-solid matter without clogging at the impeller. The outstanding features of these pumps, which are manufactured in both vertical and horizontal designs, are the volute casing with special provision for smooth flow and ready access to internal parts, and the impeller, which is made of bronze or hard cast iron as conditions may demand. The impeller is semi-open, with two heavy curved vanes to form extra large water passages. It is finished smooth on the inside with rounded ends, is adjusted to rotative balance, runs with minimum clearance, and is of a design which does not permit rags to grind between the vanes and casing. For some of the pump sizes, the impeller is designed to pass solids of 1-inch smaller dimension than the pump suction and discharge diameter.

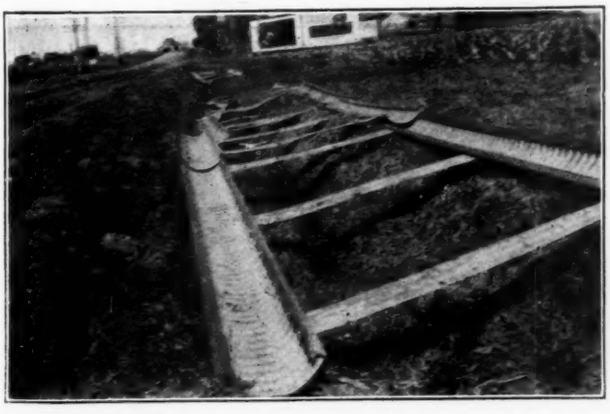
IMPELLER OF 10" PUMP AND MATERIAL PASSED BY IT

With pump units of the horizontal type (the vertical type, shown in the illustration, have the same internal mechanism), the casing is furnished either solid or horizontally slit, as may be desired; the radial and thrust ball bearing of the vertical type are replaced by double enclosed, double-ring oiling babbitt-lined bearings with ball or roller thrust between, and a suitable bed plate is provided for mounting the pump and driving motor together.

These pumps are built in sizes having suction and discharge openings ranging from 3 inches to 20 inches and impellers from 8 inches to 40 inches, to pass solids of maximum dimension ranging from 2 inches to 12 inches and for maximum capacities of from 250 to 16,000 U. S. gallons per minute. A 12-inch and a 10-inch pump of this type have been installed by the Brooklyn, N. Y., Bureau of Sewers.

METALRUT FOR IMPASSABLE ROADS

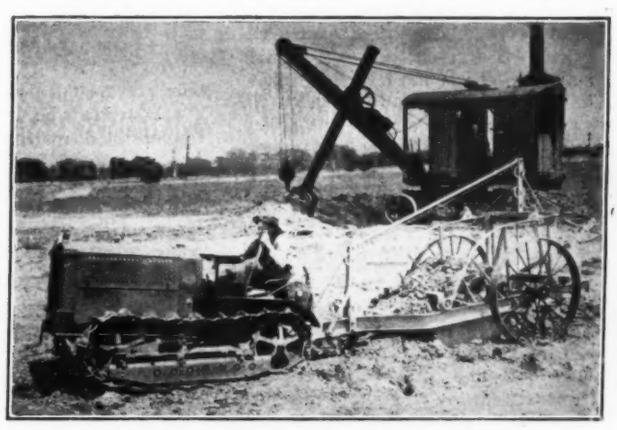
The Metalrut Co., St. Paul, Minn., manufactures "Metalrut," which is designed to move traffic through mud holes, washouts, snowdrifts, sand, soft dirt, or other emergencies. It consists of heavy-gauge corrugated-metal curved troughs for the wheels. These are held together in a parallel position by corrugated struts. Metalrut is built in 10-foot sections for easy handling, stacking and laying, and in two weights, standard and heavy duty. To use Metalrut, the mud, muck or sand should be leveled off so that each trough has a good bearing for its entire length, and the sections lapped two corrugations and bolted together. Two men can handle easily a section of Metalrut, thus making handling and placing cheap and rapid. It is especially suited to maintaining traffic around detours, and for hauling dirt or road material over soft places, through dirt and over fresh subgrade. Trucks can move forward or backward, and will not climb out of the trough.



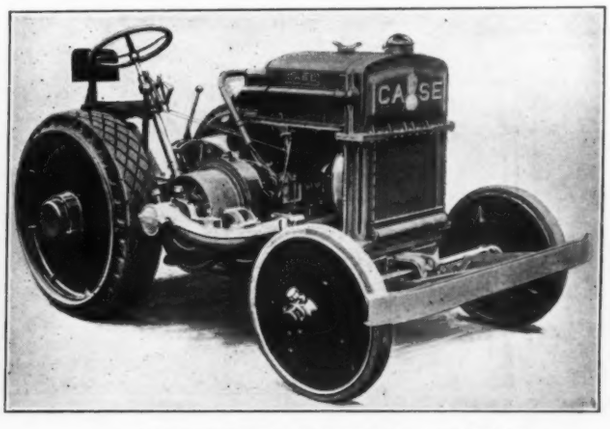
METALRUT FOR BAD ROADS

MIAMI POWER SCRAPER WITH CLETRAC TRACTOR

The Miami Trailer-Scraper Co., Troy, O., has brought out a new model of the Miami Scraper for use in connection with the Model "20" Cletrac tractor. The Miami One-Man power scraper is a power scraper whereby one man, the tractor driver, loads, transports and automatically dumps three-quarters of a yard of earth every trip without stopping the tractor. When desired, the scoop pan can be filled with a full rounded load of earth running from 21 to 24 or 25 cubic feet.



NEW MODEL MIAMI SCRAPER



NEW CASE INDUSTRIAL TRACTOR

It is impossible to stall the Miami scraper, for the scoop pan is always under the control of the operator, who raises it or lowers it as desired. This control is positive through the Miami power winch, which is furnished with each scraper and which mounts on the tractor. The positive control of the scoop pan through the Miami power winch enables the driver to dump the load whenever or wherever wanted. When the pan has been filled to capacity, the driver pushes forward on the lever and raises the pan off the ground so that the front end is at about a 15 degree angle. In this position the load is transported to the dump on roller bearing wheels with a very slight loss even from a full rounded load.

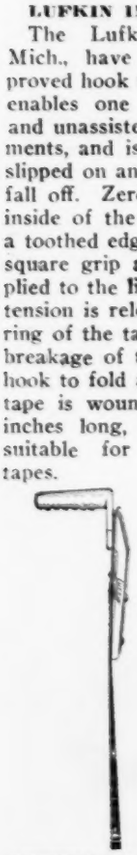
CASE INDUSTRIAL TRACTOR

The J. I. Case T. M. Co., Racine, Wisc., has just placed on the market a new industrial tractor especially designed for general industrial and construction use. The machine is compact and low, with a very low center of gravity and a 10-foot turning radius. Two-thirds of the weight is borne by the rear wheels, which are cast hollow so that, when extra traction is desired, they can be filled with sand. Wheels have rubber tires.

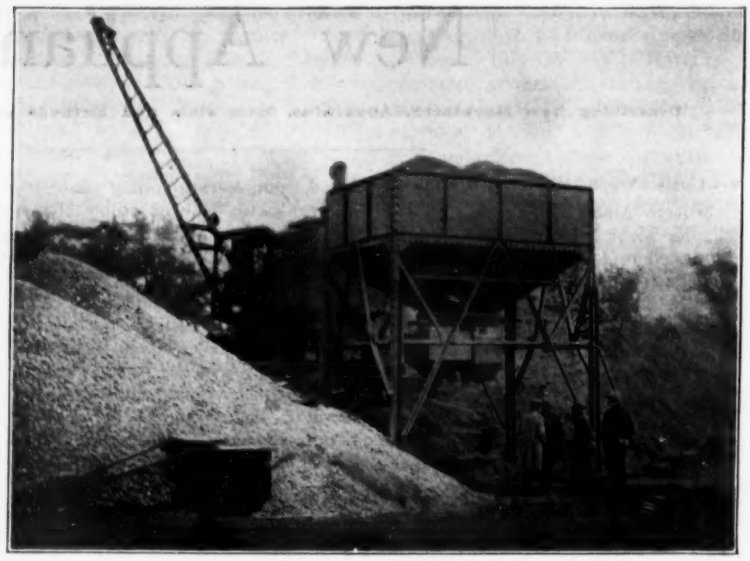
The tractor is rated at 12 h.p. on the drawbar and 20 h.p. on the belt pulley, which is provided. The control and operation are exceedingly simple, and all controls are in easy reach of the driver, who sits on a spring-mounted seat with back rest.

LUFKIN IMPROVED TAPE HOOK

The Lufkin Rule Co., Saginaw, Mich., have just announced an improved hook for steel tapes. This hook enables one man to take accurately and unassisted, long or short measurements, and is inexpensive. It is easily slipped on and off the tape, yet cannot fall off. Zero of the tape falls at the inside of the hook, and the hook has a toothed edge, which takes a firm and square grip as soon as tension is applied to the line, and releases when the tension is released. It swings with the ring of the tape, thus guarding against breakage of the line, and allowing the hook to fold against the case when the tape is wound up. The hook is two inches long, light but strong, and is suitable for 3/8-inch standard steel tapes.



LUFKIN TAPE HOOK



A BUTLER V-40 STEEL BIN

BUTLER STEEL STORAGE BINS

The Butler Bin Co., Waukesha, Wisc., manufactures steel storage bins in capacities from 15 yards up, in three types: "V"—2-compartment; "S"—single compartment; "R"—folding bins. The "V" bins are designed to meet the needs for 2-compartment bins for construction contractors and material yards. They are built in capacities of 20, 40, 75 and 110 yards, the smaller sizes being readily portable. The V-40, illustrated herewith, is especially suited for road or building contractors, as it has ample capacity, yet is of such design and construction that it is possible to take it down or erect it quickly, and to transport it on a flat car or a platform truck. Type "S" bins are made in capacities of 15, 27, 42, 75 and 110 yards. They are entirely of steel shapes and plates, with no cast parts. As in all Butler bins, the main sections are bolted, not riveted, so that damaged parts may be removed and straightened at any blacksmith shop. Type "R" bins are 2-compartment, folding bins, made in two sizes, 20 and 34 cubic yards. They are designed for use in city construction work and on construction jobs where an easily portable bin is required.

Type V bins are described in Bulletin 100; type S bins in bulletin 110; type R bins in bulletin 120. Butler measuring hoppers and bin gates are described in bulletins 130 and 140. These bulletins may be obtained from *Public Works* or from the Butler Bin Co., Waukesha, Wisc.

SEMI-TRAILER HITCHES FOR TRACTORS AND TRUCKS.

The Trail-It Co., St. Paul, Minn., manufactures the Trail-It Hitch, which, it is claimed, has many advantages of handling, and is a practical hauling unit of low cost and great economy. The Trail-It Hitch consists of gooseneck beams which are attached to the semi-trailer and to the tractor (it is designed especially for use with the McCormick-Deering and the Fordson tractors) by means of a top plate and a king-pin. This arrangement permits the pay load to be carried on the tractor, adding tractive power and distributing part of the load to the front wheels, giving perfect steering control. It permits a very short turn, and rapid coupling and uncoupling. Trail-It Hitches are claimed to have almost unlimited applications of use in dirt moving, waste handling, oiling, sprinkling, scraping, and hauling generally.

NATIONAL AIR COMPRESSORS

The National Brake & Electric Co., Division of the Westinghouse Air Brake

TRAIL-IT HITCH ATTACHED TO TRACTOR

NEW CATALOGS

Automatic Cone Valve Co., Chicago, Ill. A 12-page illustrated catalog describing the automatic cone check valve.

O. K. Clutch and Machinery Co., Columbia, Pa. An illustrated folder describing the O. K. Portable Elevator.

Austin-Western Road Machinery Co., Chicago, Ill. An illustrated circular describing the leaning wheel grader with the telescopic axle.

Paradon Manufacturing Co., Arlington, N. J. An 8-page illustrated bulletin; No. 1-M, describing Paradon chlorinators for water, sewage, and swimming pools.

Bay City Dredge Works, Bay City, Mich. Bulletin T-3. Illustrated. Describes the Bay City tractor shovel; Bulletin 27, illustrated. Describing the Model 16-B. ¾-yard convertible excavator.

Perfection Steel Body Co., Galion, O. A 16-page illustrated catalog describing Perfection Steel Dump Bodies for use with Ford trucks.

Dorsey Bros., Elba, Ala. Catalog describing Dorsey Model "B" Stump Puller, and other equipment.

Fisher Scientific Co., Pittsburgh, Pa. A 16-page illustrated catalog describing Fisher cement testing apparatus and accessories.

W. M. Blair Mfg. Co., Chicago, Ill. A 12-page illustrated catalog describing the North Hydraulic Digger.

Universal Power Shovel Co., Detroit, Mich. Bulletins Nos. 4 and 5, describing the Fordson tractor equipped Wilford power shovel, crane, and backfiller.

Trail-It Co., St. Paul, Minn. A 12-page illustrated catalog describing Trail-It semi-trailer hitches for Fordson tractors and Ford trucks.

Worthington Pump & Machinery Corp., N. Y. A 12-page illustrated Bulletin; No. W613 describing the new Worthington High-Efficiency centrifugal pumps.

Irving Iron Works Co., Long Island City, N. Y., a 12-page illustrated Bulletin, F, describing a system of reinforcement and surface armor for concrete bridge floors.

Austin-Western Road Machinery Co., Chicago, Ill. An illustrated folder, "The Long and Short of It," which describes in detail the workings of the telescopic axle and the leaning wheels.

Link-Belt Co., Chicago, Ill. Bulletin B-3, on "Clean Water" intake screens. 24 pp. Ill.

Carl Frink, Clayton, N. Y. A 16-page illustrated catalog describing Frink "Sno-Plows."

Sullivan Machinery Co., N. Y. Bulletin 83-F, 32 pp. Describes Sullivan gasoline engine driven portable air compressors, 110-ft. to 310-ft. capacities, and electric units in 103-ft. and 206-ft. sizes. Bulletin 76-F, 3rd Edition. 16 pages, describes Sullivan "Turbinair" portable hoists, single and double drum. Bulletin 81-N, 8 pages, describes Sullivan Clay Spaders, Class DH-361.

Oklahoma Engineering and Foundry Co., Muskogee, Okla. 4-page folder describing the White Tractor Hoist for use with the Fordson tractor.

Marion Steam Shovel Co., Marion, O. illustrated folder describing Marion Type 7, straight gas shovel, dragline, and crane.

Universal Power Shovel Co., Detroit, Mich. A 24-page illustrated catalog describing the Wilford Power Shovel and attachments.

Keystone Driller Co., Beaver Falls, Pa. An illustrated 60-page catalog describing Keystone Blast Hole Drills

Keystone Driller Co., Beaver Falls, Pa. An illustrated 104-page catalog describing Keystone drills.

Co., Milwaukee, Wisc., manufactures Westinghouse-National portable gas engine driven air compressor units, in which the engine and the compressor are built as an integral unit. These are made in two sizes, 110 and 160 cubic feet capacity, but in the near future will be supplied also in 240 and 330-foot sizes. The 110 and 160-foot sizes can be furnished in any conventional mounting, including skids, steel axles with rubber or steel-tired wheels, with spring suspension, on cast steel frames for mounting on truck chasses, or mounted on a Ford truck.

WESTINGHOUSE-NATIONAL PORTABLE AIR COMPRESSOR

MODEL 45 JT TRACTOR

The JT Tractor Co., Cleveland, O., has brought out its model "45" tractor, which is claimed to have several distinct improvements. A six-foot turning radius, with the hitch at the center of turning, enables the manipulation of any implement or draught in the shortest possible space.

Three forward speeds are provided. Low speed of 1 1/3 miles per hour is designed for the heaviest loads and poorest roads. The direct speed of 2½ miles per hour is used for most of the heavier hauling where speed is not so important as a steady pull. The high speed of 4¼ to 5 miles per hour is used for lighter work. These three forward speeds, together with the reverse speed of 1¼ miles per hour, make the tractor versatile and fit it to a great many different kinds of work.

The JT tractor grips the ground with 1,628 square inches of traction surface. The maker claims that it pulls in loose sand, takes hold in slippery or sticky clay, holds steady in gravel, goes through swamps and takes its load over all kinds of surfaces; and that the full crawler action gives the machine traction to the full power of the motor.

The model "45" operates with an automobile type transmission so that anyone understanding the operation of an automobile can handle a "JT."

NEW SPEEDER SKIMMER SCOOP

The Speeder Machinery Corp., Cedar Rapids, Ia., has just put on the market a new Speeder skimmer scoop which features a high and low speed on the drums as well as on the traction, a patented bucket trip, a traction lock, and a bucket that dumps from the back instead of the bottom. The traction lock prevents travel away from the work, thus assuring firm anchorage for heavy work. The usual trip rope is eliminated by the patented trip, which permits the bucket to be dumped in any position, and is therefore advantageous for work in close quarters.

The back-dump feature, which is made possible by placing the pivots near the top of the bucket instead of at the bottom, gives a dumping clearance greater than could be obtained with a bottom dump. This is very desirable in certain classes of work and adds to the life of the bucket by eliminating the hinge on the bottom. The Speeder Skimmer Scoop embodies all other Speeder features and change to the Skimmer from any other Speeder attachment is accomplished by simply changing the boom and reweaving the cables. It is full revolving, giving a wide working range and permitting wagons and trucks to be loaded from the rear. A six-foot turntable and extra large caterpillar base give sufficient stability for the use of an 18-foot boom, enabling the bucket to fill on very shallow cuts and giving an added height to the dumping clearance.

NEW SPEEDER SKIMMER SCOOP

WILFORD POWER SHOVEL.

The Universal Power Shovel Co., Detroit, Mich., manufacturers the Wilford Power Shovel, which is a small shovel operated by the Fordson power unit. It is a quarter-yard outfit, readily convertible from power shovel into clam-shell, crane and back-filler, through interchangeable booms. It possesses unusual speed and mobility, and is entirely one-man operated; it travels under its own power at 2½ to 3 miles per hour. There is claimed for it low first cost, low operating costs and slow depreciation; while service is provided by the huge Ford organization. It is suited for grading, road construction, material handling, shallow grading, and ditch digging. The narrow tread and crawler construction is often of advantage in this work.

MODEL 45 JT TRACTOR

WILFORD POWER SHOVEL

INDUSTRIAL NOTES

KENNEDY VALVE CO.

The Kennedy Valve Manufacturing Company of Elmira, N. Y., announces the appointment of R. J. Flanagan as manager of its Chicago sales office and warehouse. Mr. Flanagan has been connected with the company for a number of years, both in the plant at Elmira and in the sales department. His previous position as Elmira district representative is being taken by J. T. Connelly who has been transferred to Elmira from the Cleveland sales office, and W. E. Blake is to replace Mr. Connelly in Cleveland.

NEW DISTRIBUTORS FOR TRACKSON FULL-CRAWLERS

The Trackson Company, Milwaukee, Wis., announces the appointment of two new distributors for its machines, Trackson Full-Crawlers for the Fordson tractor. The Tractor Equipment Company, 701 S. Broadway, Denver, Col., will have the Denver territory, and the Monarch Auto Company, Louisville, Ky., will cover the Louisville territory. Both of these companies will carry the standard Model F and the heavy-duty Model D Trackson Full-Crawlers, and repair and replacement parts. Ford dealers in these territories will be assured henceforth of prompt and efficient attention to parts orders and service.

The Allen Equipment Company, 331 So. Rio Grande Ave., Salt Lake City, Utah, has been appointed the distributor in the Salt Lake territory for Trackson Full-Crawlers, manufactured by the Trackson Company, Milwaukee, Wis., according to an announcement made by that company.

Both the standard Model F and the heavy-duty Model D Full-Crawlers will be handled by the new distributor, with a complete stock of repair and replacement parts.

MOHAWK ASPHALT HEATER CO.

The Mohawk Asphalt Heater Co., Schenectady, N. Y., has appointed H. F. MacMinn representative for New York and the metropolitan territory. Mr. MacMinn will handle the "Hot-stuf" asphalt heater and the Mohawk oil burner.

LARGEST SHIPMENT OF ELECTRIC SNOW MELTERS

Shipments of over 1060 electric snow melters for railway track switches are now being made to the Interborough Rapid Transit Company of New York City by the Westinghouse Electric and Manufacturing Company. Electrical snow melters have been used by many transportation companies during the past two years and have given exceptional service by keeping track switches open and operating during heavy snow and sleet storms. These units are so installed that sufficient heat is generated at the important points of each switch to prevent the collection of snow or the formation of ice. Each switch group of heaters is individually connected to the power line by a fuse and single throw switch and the yard men can turn them on whenever occasion demands.

R. L. Wilson, works manager of the East Pittsburgh works of the Westinghouse Electric and Mfg. Co., has been appointed assistant to the vice-president and general manager; J. M. Hipple, manager of the Motor Engineering Department, succeeds Mr. Wilson as works manager.

GENERAL WHEELBARROW CO.

The Akron Barrow Co., Cleveland O., has changed its name to the General Wheelbarrow Co.

BOONE & WESTER

Boone & Wester, engineers and contractors, Cedar Key, Fla., have discontinued their offices at Palatka and St. Augustine.

WADE ENGINEERING CO. MOVES.

The Wade Engineering Co., Los Angeles, Calif., which handles products of the Lincoln Electric Co., Cleveland, O., has moved its northern office from 69 Webster St. Oakland, to 533-539 Market St., San Francisco.

NEW CLIMAX SERVICE STATION

The Climax Engineering Co., Clinton, Iowa, announces the appointment of John Reiner & Co., Inc., 309 Church St., New York City, N. Y., as Climax service representatives for the states of Connecticut, New York and New Jersey. This company will maintain a complete assortment of repair parts for all models of Climax engines and have available a corps of experienced service engineers so that users will be assured of reliable parts and labor service at all times, in addition to keeping a selection of Climax engines and industrial power units in stock for sale and prompt shipment.

AGENT FOR COFFIN VALVES

The Coffin Valve Co., Boston, Mass., has appointed the Chapman Valve Mfg. Co. as exclusive sales agent in the United States, Canada, Mexico, and Cuba, for the sale of Coffin sluice gates, shear gates, tide flap valves, etc.

MIAMI TRAILER-SCRAPER CO.

The Miami Trailer-Scraper Co., Troy, O., manufacturer of the Miami One-Man Power Scraper, which was described in the September issue of PUBLIC WORKS, has adapted this scraper to use with the Cletrac 20-K tractor, as well as with the McCormick-Deering, Caterpillar and Fordson tractors.

ALEXANDER MILBURN CO.

The Alexander Milburn Company, Baltimore, Md., manufacturer of welding and cutting apparatus, portable carbide lights, oil burners and preheaters, and paint and lacquer spraying equipment has opened The Alexander Milburn Sales Company, Wiggin Terminals Building, 50 Terminal Street, Boston, Mass. This office is under the supervision of M. B. Crouse and G. B. Malone.

W. H. ANDERSON TOOL & SUPPLY CO.

Frank D. Messenger, formerly of the Michigan State Highway Department, has joined the sales organization of the W. H. Anderson Tool & Supply Co.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, etc., required by the Act of Congress of August 24, 1912, of Public Works, published monthly at New York, N. Y., for October 13th, 1927.

State of New York, County of New York, ss.: Before me, a Notary Public in and for the state and county aforesaid, personally appeared James T. Morris, who, having been duly sworn according to law, deposes and says that he is the business manager of Public Works, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and, if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, printed on the reverse side of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business editor and business manager are:
Publisher—Public Works Journal Corporation, 243 West 39th Street, New York, N. Y.
Editor—A. Prescott Folwell, Montclair, N. J.
Managing Editor—A. Prescott Folwell, Montclair, N. J.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total of stock.)
Public Works Journal Corporation, 243 West 39th Street, New York, N. Y.
Sumner W. Hume, 243 West 39th Street, New York, N. Y.
James T. Morris, White Plains, N. Y.
A Prescott Folwell, Montclair, N. J.
Contracting Pub. Co., New York, N. Y.
Stockholders of Contracting Publishing Co.:
H. F. Pomeroy, 33 W. 42nd St., New York, N. Y.
J. R. Breuchaud, 342 Madison Ave., N. Y. City.
H. F. Hackerdorn, Consumers Bldg., Chicago, Ill.
Frank W. Skinner, 20 Vesey Street, N. Y. City.

3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are:
Swetland Publishing Company, 239 West 39th Street, New York, N. Y.

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also, that the said two paragraphs contain statements embracing affiant's knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association or corporation has any interest, direct or indirect, in the said stock, bonds or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is (This information is required from daily publications only).

JAMES T. MORRIS, Business Manager.

Sworn to and subscribed before me this 13th day of October, 1927.
(Seal)
H. H. MINER,
Notary Public, No. 228, New York County,
Register's No. 8051
(Commission Expires March 30, 1928)